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Pennsylvania

Streamline Steam Locomotive

THE Pennsylvania has recently turned out from the Altoona shops a Class K4s Pacific type locomotive and tender which has been completely streamlined by cowling over the boiler and skirting which extends down from the running board and around the front of the locomotive. The cab is faired into the lines of the locomotive, and the tender has been made to continue the lines of the locomotive by curved sides above the top of the tender, which conform to the sides of the cab roof. The top of the tender is not enclosed. The bottom of the skirting and tender form an unbroken line with the bottom of the coach sides when the locomotive is coupled to a train.

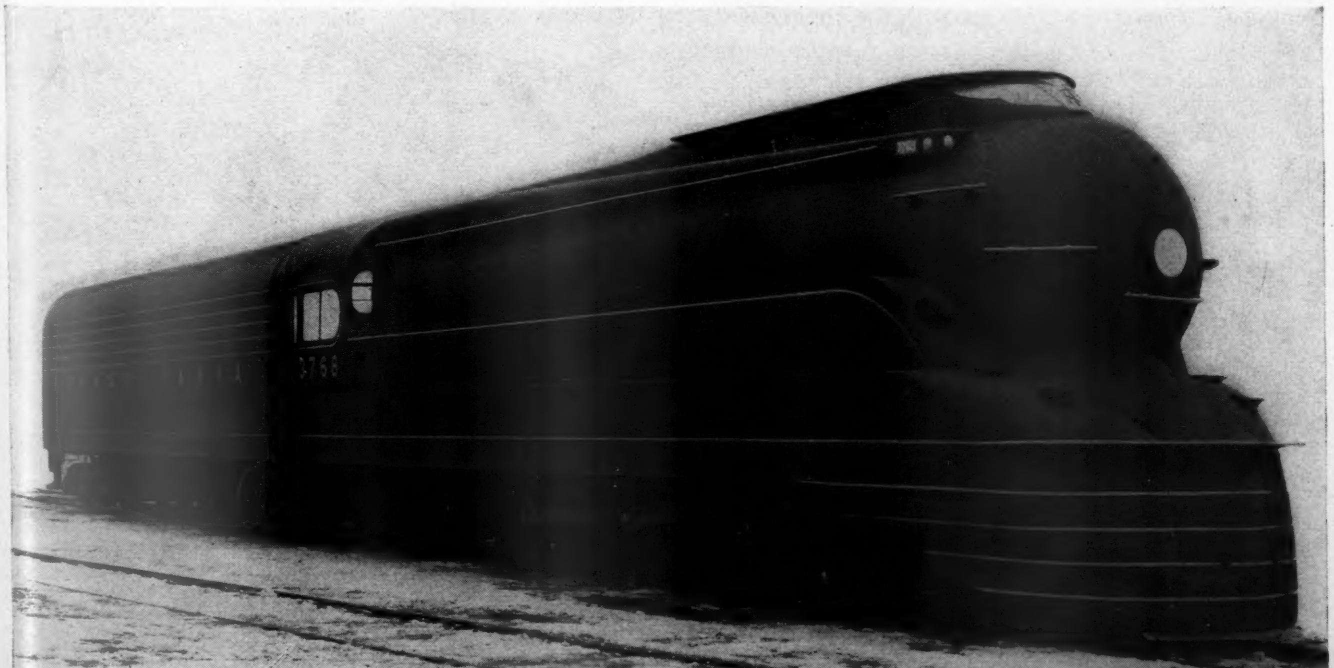
An outer diaphragm of heavy sheet rubber closes the space between the front of the tender and the rear of the cab, which is entered by side doors at the gangway behind the enginemen's seats. This diaphragm, which is put up under tension, provides a smooth, continuous surface between the engine and tender while standing on straight track, and stretches as much as is necessary to conform to the relative movement between the engine and tender on curves.

The body color is a gun metal tone against which the striping stands out sharply. The letters and the stripes on the tender and around the cab windows are in gold. The stripes on the engine are stainless steel, as are also the handrails on the sides and front end and the winged keystone emblem on the cowling in front of the stack.

By the separation between the front end of the boiler and the skirting in front of the pilot and around the cylinders the characteristic appearance of the steam locomotive has been retained. Aside from its pleasing appearance this separation is said to reduce the tendency to develop low-pressure pockets along the sides of the boiler at the front of the cab, which is characteristic of the so-called shovel-nose form. A further division of the air stream toward the same end is effected by a horizontal plane projecting around the front end of the locomotive at approximately front deck-plate height.

The smoke-lifting device consists of the stack cowling, enclosing a space of considerable width at the sides of and behind the stack, which is closed at the top by a horizontal plane flush with the top of the stack and extending somewhat beyond the cowling at the front and sides. Along each side of the boiler, starting with the enclosure for the classification lights at the front is a plane, the lateral elements of which are horizontal, which slopes upward toward the rear and blends into the contour of the cab roof. The space between each of these planes and the under side of the projecting horizontal plane is thus narrowed toward the rear, tending to produce a slight increase in air pressure and velocity at the rear end of the horizontal plane. This is said to remove all tendency for smoke to trail along the top of the boiler and the lateral component of the increased pressure in the air stream between the two planes is also a factor in reducing low-pressure spots along the side of the boiler toward the front of the cab.

The front end of the locomotive is completely equipped with a coupler and both brake and signal hose connec-



tions. When not in use the coupler is swung back horizontally and the hose connections are dropped into place behind the contour of the skirting which is closed by a panel permanently attached to the locomotive and which moves up and back within the skirting when opened.

The boiler cowling and cab are fabricated of sheet steel. The skirts below the running boards are of aluminum sheets. A long panel of each skirt is arranged to be completely removed by removing a few bolts when access to the rods and motion work is required in the enginehouse or shop. Doors have been provided at points where access for lubrication is not otherwise available. The smokebox and smokebox front have been lagged to protect the cowling from the heat. Openings in the cowling are provided over the whistle and pops, the location of which has not been changed. The sand box, however, has been moved forward immediately behind the stack. The bell is mounted on the engine frame under the cowling at the front of the locomotive.

The tender has 18,000 gal. capacity. The water tank is provided with two longitudinal filling holes, one in each side. The panels in the curved extensions of the tender sides opposite these openings are arranged so they may be unlatched and rolled laterally toward the center of the tank to clear the filling holes.

The locomotive as altered has a weight in working order of 337,850 lb. and the weight of the tender loaded is 289,700 lb. The overall length is 95 ft.

The design of the streamlining was developed by the railroad's engineering department in co-operation with Raymond Loewy, New York, an authority on streamlining and a member of the road's technical advisory staff. In working out the final design tests were carried on over a period of months in the wind tunnel of the New York University aerodynamic laboratory. Instead of the usual type of wood or metal models, clay models were used for the first time in these experiments. They demonstrated their superiority over the other materials because of the readiness with which shapes could be altered immediately upon observing the results of each test. Observations of air flow were made by the use of both silk threads and smoke bombs.

The comparative wind-resistance tests were made with models of the locomotive, tender and one coach. Under these conditions at wind-tunnel speeds of 100 m.p.h. the air resistance was reduced from 896 hp. with a conventional locomotive to 600 hp. with the streamliner.

Roller-Bearing Journal Box with Lateral-Motion

With the application of roller bearings to locomotive driving axles the Franklin Railway Supply Company, New York, one of the first to provide controlled lateral for locomotive driving axles, became interested in developing a means of applying this principle to roller-bearing journal boxes.

On locomotives with plain crown-bearing journal boxes the control and cushioning of lateral motion has been largely confined to one or two axles for the primary purpose of keeping the rigid wheel base within practical limits on locomotives with long coupled wheel bases. In the case of the roller-bearing journal box, however, because of the absence of lateral motion within the bearing itself there is to be considered the added function of providing some cushioned lateral movement within the parts of the journal box to protect the axle bearing, frames and parts from shocks received through the track. To meet these conditions this company has developed a type of lateral-motion journal box which is adapted to either self aligning or radial type roller bearings and is applicable on either inside or outside journal bearings, the latter including those on trailer, tender and passenger-car trucks.

For both types of bearings the complete lateral motion journal box consists essentially of an inside box which houses the roller bearing and an outside box which fits into the pedestal of the locomotive or truck frame or is otherwise attached to the truck frame. The inside box conforms to the outside of the roller-bearing assembly and is essentially cylindrical in form. Within it are provided the necessary seals for retaining the roller-bearing lubricant. On the top of the inside box is doweled the spring seat or the spring-saddle seat, as the case may be. The outside box is open on the side next to the wheel hub and, in assembling, is slid onto the inner box in a direction parallel to the axis of the journal. The top of the outer box is also open for the doweled seat of the inner box on which the load is carried.

Lubrication of the sliding surfaces between the inner box and the driving box is provided from an oil pocket in the spring-saddle seat. Pockets in the top of the outer, or driving box, feed oil to the pedestal shoe and wedge faces. In the trailer box the oil pockets in the

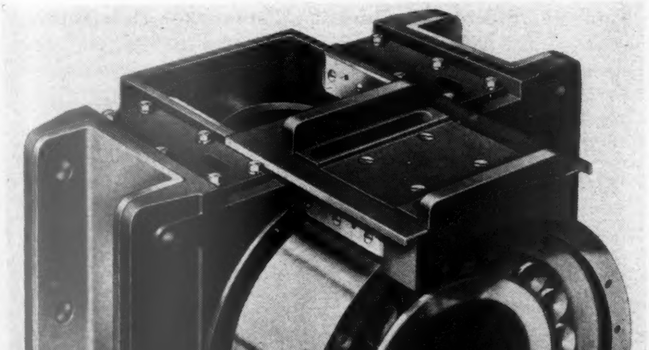
The brake and signal hose connections and the coupler are always ready for service—The panel rolls back behind the shrouding

outer box supply lubricant to both surfaces. Alemite fittings in the inner box extend through free openings in the closed end of the outer box.

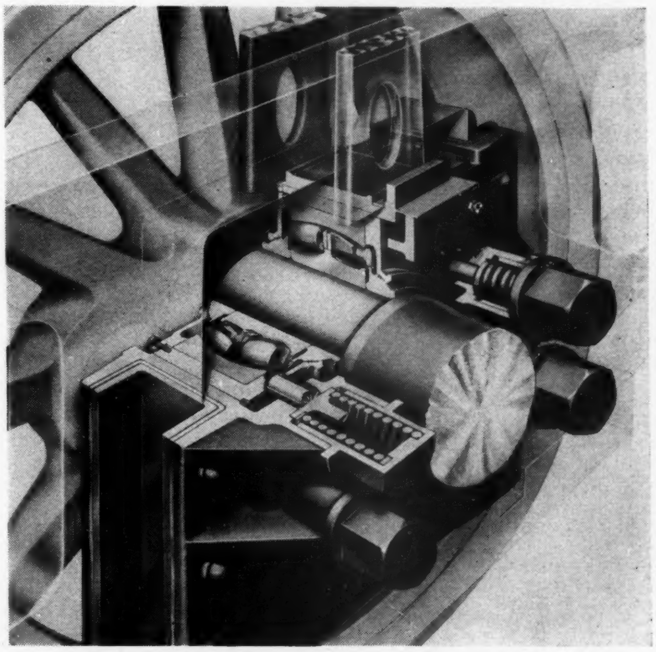
On the closed face of the outer box are a number of spring pockets which are parallel to the axle. Within each pocket is a coil spring which bears against a plunger projecting into the outer box toward the end surface of the inner box from which it is normally separated by a clearance of $\frac{1}{64}$ in. The lateral movement of the axle and the roller-bearing assembly with its inner box brings the latter into contact with the ends of the plungers in the outer box and builds up resistance against the movement by the compression of the springs. With the removal of the force causing the lateral movement of the axle the springs acting on the plungers restore the inner box to its normal or central position within the outer box.

The illustrations show a driving box designed for SKF self-aligning bearings. With this type of bearing the movement required to accommodate the variable inclinations of the axle with respect to the frames takes place within the bearing itself, and full-length bearing surfaces between the flanges of the outer or driving box and the pedestal shoe and wedge surfaces can be maintained. The only friction load on the sliding surfaces between the inner and outer boxes is what may be imposed by braking reactions and, in the case of driving boxes, by the piston thrust. The main bearing load is carried directly on the inner box.

With a journal box of this kind it is possible to provide the amount of lateral cushioning force desirable on any particular axle, depending upon its location in the wheel base. By the number of cushioning springs built into the box and the initial load adjustment the amount of resistance can readily be developed to supplement the resistance of the leading truck or the trailing truck in any proportion to provide proper riding quality both at speeds and on curves. In the case of the drivers it can also be varied to meet the conditions of location and, hence, to provide the proper flexibility in order to negotiate curves and overcome the disadvantages of a too long rigid wheel base. The cushioning of the lateral not only tends to increase the life of the mechanism, including flanges, wheels, axles, bearings and boxes, but also reduces stresses on the rail and roadbed. By reducing flange clearance it would be possible with journal boxes of this type to replace what is in reality a free lateral movement between the flange and the rail with a cushioned and controlled lateral movement within the lateral-motion journal box.



The inner box, with its inside cover removed, partially inserted in the outer box—When completely assembled all bearing surfaces are protected from dust



Lateral-motion roller-bearing driving box cut away to show the relation between the parts

Journal boxes of this type have been in service on the front driving boxes and the front trailer boxes of two Delaware, Lackawanna & Western 4-8-4 type locomotives since December, 1934, one of these locomotives operating largely in passenger service and the other largely in freight service. In this installation the maximum lateral permitted within the driving boxes is $\frac{5}{8}$ in. and within the trailer boxes, 1 in. Observations made by the use of Bowden wires attached to one plunger each in a driving box and a trailer box indicate that in approaching a curve the lateral-motion boxes permit the axle to adjust itself smoothly and gradually and no side sway of the locomotive was evident either on tangent track or on curves due to a jerky lateral movement of the axles. When operating in the yard and in pusher service the lateral movement within the driving boxes varied up to a maximum of $\frac{1}{4}$ to $\frac{3}{8}$ in., both in forward and backward motion. In backward motion the springs in the trailer box were compressed $\frac{5}{8}$ in. under conditions of severe curvature, and in forward motion not more than $\frac{3}{8}$ in. Examination of the boxes, however, indicates that at times there have been lateral movements up to the maximum permitted by the design of the boxes. In road passenger service a reduction in the initial lateral force on the trailer boxes from 31.6 per cent to approximately 21 per cent of the wheel load was found to effect a smoother operation of the trailer. The initial force in the driving box has been maintained at 31.6 per cent of the wheel load.

Horsepower and Grate Area

By Paul T. Warner

Formulas for evaporation and boiler horsepower apply only when sufficient grate area is provided

IT is a generally recognized fact that the true measure of a locomotive's capacity is the horsepower that it is capable of developing at various speeds. A statement covering tractive force means nothing unless the speed at which that tractive force is exerted is included. The product of the two is directly proportional to the horsepower.

It is also recognized that the factor which primarily determines the maximum horsepower that a locomotive can exert is the steaming capacity of the boiler. Locomotives are invariably proportioned so that, except at slow speeds, the cylinders can utilize all the steam that the boiler produces; hence, while the efficiency with which the steam is utilized is of importance in determining the indicated horsepower, the factor first to be considered is the boiler. This is evident in all the tentative methods for determining locomotve horsepower that have been worked out during recent years. The best known of these is probably that developed by F. J. Cole and published by the American Locomotive Company in 1914. This method is used as the basis for that recently presented by A. I. Lipetz before the American Society of Mechanical Engineers and which Mr. Lipetz uses in determining the horsepower of a number of recent high-capacity locomotives.

Table I—Factors of Evaporation for Firebox and for Tubes and Flues of Varying Lengths

FIREBOX:—Allow an evaporation of 55 lb. per sq.ft. of heating surface per hour for ordinary fireboxes, including combustion chamber, arch tubes ard thermic syphons. Test data for watertube fireboxes are meagre; a tentative rate of 42 lb. has been proposed.

FEEDWATER HEATER:—If locomotive is equipped with a feedwater heater or an exhaust steam injector, multiply the calculated total evaporation by 1.08.

Tube length, ft.	Evaporation, lb. per hr.	Tube length, ft.	Evaporation, lb. per hr.
10.0	13.00	18.0	9.85
10.5	12.75	18.5	9.70
11.0	12.55	19.0	9.50
11.5	12.30	19.5	9.35
12.0	12.10	20.0	9.20
12.5	11.80	20.5	9.05
13.0	11.65	21.0	8.95
13.5	11.45	21.5	8.80
14.0	11.25	22.0	8.65
14.5	11.10	22.5	8.55
15.0	10.90	23.0	8.40
15.5	10.70	23.5	8.30
16.0	10.50	24.0	8.20
16.5	10.35	25.0	8.20
17.0	10.20	26.0	8.20
17.5	10.00		

The Baldwin Locomotive Works has presented, in its quarterly magazine "Baldwin Locomotives," a method developed by Thos. R. Cook for determining what is called the "potential horsepower" of a locomotive. In many respects this follows the well-known Cole method, but it is easier to apply as it uses only data that can be readily obtained, while the Cole method is based partly on the spacing of the boiler tubes, which usually cannot be obtained without a print of the boiler. In utilizing the Cook method the amount of steam that the boiler is considered capable of producing per hour is first calculated and this amount is then divided by a factor representing the assumed steam consumption per horsepower-hour. The result gives the horsepower that the locomotive is capable of developing, except at slow speeds when the cylinders cannot utilize all the steam that the boiler is capable of producing.

In figuring the boiler output it is assumed that 55 lb. of water can be exaporated per hour for each square foot of heating surface of the ordinary firebox, including combustion chamber, arch tubes and syphons, and that the tube and flue heating surfaces will evaporate amounts varying with the length of the tubes, as given in Table I. An additional evaporation of 8 per cent is assumed if a feedwater heater is applied. As the test data from boilers with water-tube fireboxes are quite meagre, the evaporative factor for such fireboxes can not be taken with any certainty. A tentative rate of 42 lb. per square foot per hour has been suggested. It is also assumed that sufficient coal can be burned on the grate to evaporate these amounts of water. The assumed steam consumption per horsepower-hour for different pressures and degrees of superheat is given in Table II.

As this method covers a wide range of tube lengths, steam pressures and degrees of superheat, the author

Table II—Steam Consumption Factors for Determining Potential Horsepower

Steam pressure, lb.	Pounds of steam for potential horsepower-hour			
		Degrees of superheat and type of superheater		
	Saturated steam	150 Type A, small	200 Type A, large	250 Type E
150	29.75	22.40	21.30	29.25
155	29.60	22.20	21.10	20.00
160	29.30	22.00	20.85	19.80
165	29.10	21.85	20.75	19.70
170	29.00	21.75	20.60	19.50
175	28.75	21.65	20.40	19.30
180	28.60	21.45	20.25	19.20
185	28.40	21.30	20.10	19.05
190	28.30	21.25	19.90	18.90
195	28.10	21.10	19.80	18.80
200	28.00	21.00	19.70	18.70
205	27.80	20.90	19.60	18.60
210	27.75	20.80	19.50	18.50
215	27.60	20.70	19.40	18.40
220	27.50	20.65	19.30	18.30
225	27.40	20.55	19.25	18.25
230	27.30	20.50	19.10	18.20
235	27.20	20.45	19.05	18.15
240	27.10	20.35	19.00	18.10
245	27.00	20.25	18.90	18.00
250	26.90	20.20	18.85	17.95
255	26.85	20.15	18.80	17.90
260	26.80	20.10	18.75	17.85
265	26.75	20.05	18.75	17.80
270	26.65	20.00	18.75	17.80
275	26.60	20.00	18.75	17.75
280	26.55	19.95	18.70	17.75
285	26.50	19.90	18.70	17.75
300	26.45	19.85	18.65	17.70
325	26.40	19.80	18.65	17.70
350	26.35	19.80	18.65	17.70

1—Allow 150 deg. F. added by Type A superheater—small or original design—where the number of tubes divided by the number of flues is greater than six.

2—Allow 200 deg. F. added by Type A superheater—large or improved design—where the number of tubes divided by the number of flues is less than six.

3—Allow 250 deg. F. added by Type E superheater.

recently applied it to a large number of locomotive designs in order to determine not only their relative efficiency, but also whether they had grates of sufficient size to generate the amounts of steam required by the formula. The general results of this study, which proved most interesting, are presented in this paper. All the locomotives considered are of the two-cylinder, single-expansion type, with fireboxes of conventional design, suitable for the use of bituminous coal as fuel. They were selected more or less at random, but are representative of the motive-power practice of their respective periods, and no designs that could in any way be regarded as "freaks" were included.

Relation of Firing Rate to Evaporation

The first step in this investigation was to determine a definite relationship between the rate of firing per square foot of grate per hour and the evaporation per pound of coal burned. This relationship is shown in Fig. 1. The curves here presented—one of which applies to locomotives using saturated steam and the other to locomotives equipped with superheaters—are based chiefly on Pennsylvania tests and on information presented by F. J. Cole before the New York Railroad Club on November 21, 1901. The curves are, of course, only approximations, as locomotive boilers show widely different results in water evaporation at various rates of firing, but for the purpose of comparison they are reasonably satisfactory. No two persons, working independently, would produce curves of this kind that would show exactly the same results, and it is impossible, without actual tests, to determine the exact amount of water per pound of coal that any given boiler will evaporate.

It early became evident that locomotives fitted with superheaters and saturated steam locomotives with wide fireboxes would, when burning coal of reasonably good quality, develop their potential horsepowers at firing

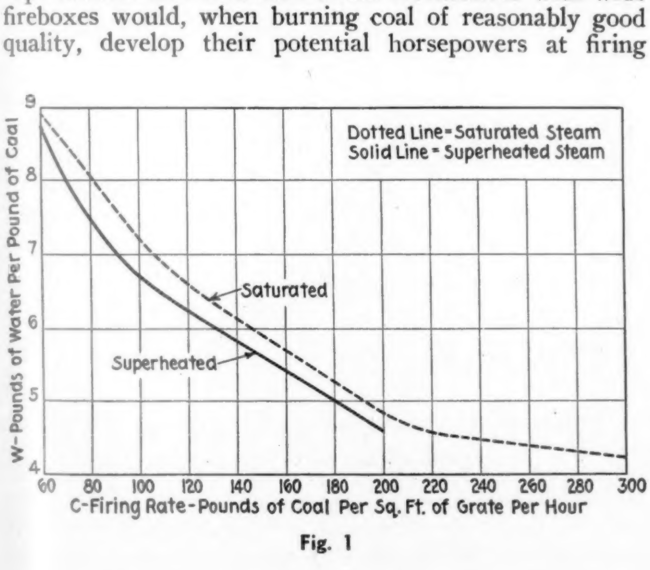


Fig. 1

rates well under 200 lb. an hour, but that many locomotives with narrow fireboxes would show very much higher rates. Accordingly, the curve for saturated steam locomotives was extended to show an evaporation of 300 lb. per square foot of grate per hour. This extension of the curve is open to criticism, as there are very few locomotive boilers in which it would be possible to burn coal at such a high rate. Furthermore, when boilers are being unduly forced, the actual evaporation frequently drops off even with an increase in the rate of firing. A 300-lb. rate, however, has been reached on the Altoona plant in a 4-8-2 type superheated locomotive having a comparatively moderate amount of grate area, but a large combustion chamber and furnace volume. By extending the curve to 300 lb., it has been possible to include in the study a considerable number of narrow firebox locomotives which would otherwise be entirely outside the range of calculation.

For any given boiler the firing rate, when developing full potential horsepower, is largely dependent upon two factors—the number of square feet of heating surface per square foot of grate area, and the equivalent evapora-

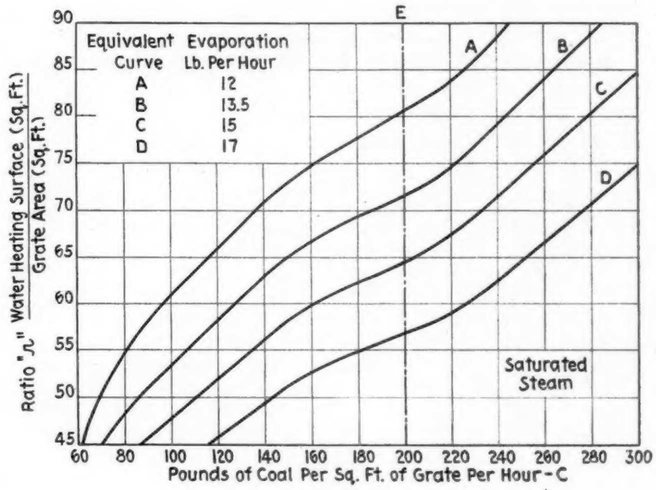


Fig. 2

tion rate per square foot of heating surface. The latter factor is obtained by dividing the total calculated evaporation per hour by the total evaporative heating surface. It is evident that increasing the firebox heating surface in proportion to the total, or reducing the length of the tubes, will increase the equivalent evaporation rate.

Ratio of Heating Surface to Grate Area

The relation between evaporation per pound of coal and the rate of firing (Fig. 1) having been determined, two sets of curves—one (Fig. 2) for saturated and one (Fig. 4) for superheated locomotives—were plotted to show the relation between ratio of heating surface to grate area and coal consumed per square foot of grate per hour for different rates of equivalent evaporation. These cruves are based on the following equations:

Let

g = grate area in square feet
h = water heating surface (total) in square feet
e = equivalent evaporation in pounds per hour per square foot of heating surface
w = pounds water evaporated per pound of coal
c = firing rate (pounds of coal per square foot of grate per hour)
r = ratio of h to g

Then

$$h \times e = \text{pounds water evaporated per hour} = g \times c \times w$$

Hence

$$c = \frac{h \times e}{g \times w}$$

and if we let

$$\frac{h}{g} = r$$

$$c = r \times \frac{e}{w}$$

For any given locomotive the value of *e* should first be determined by calculating the total evaporation in pounds per hour and dividing this figure by the total evaporative heating surface. A value for *w* must then be selected, by the "pick and try" method, that agrees with the corresponding value for *c* as given in Fig. 1. Thus, let it be assumed that in the case of a certain

locomotive using saturated steam the value for r is 60 and for e, 12. Then $c = \frac{720}{w}$. If we assume a value of 120 for c, the corresponding value for w, as gvien by the formula, will be 6.0. Fig. 1, however, shows that with a firing rate of 120 lb. the corresponding evaporation, using saturated steam, is 6.6 lb. If now the firing rate is assumed to be 100 lb., the corresponding evapora-

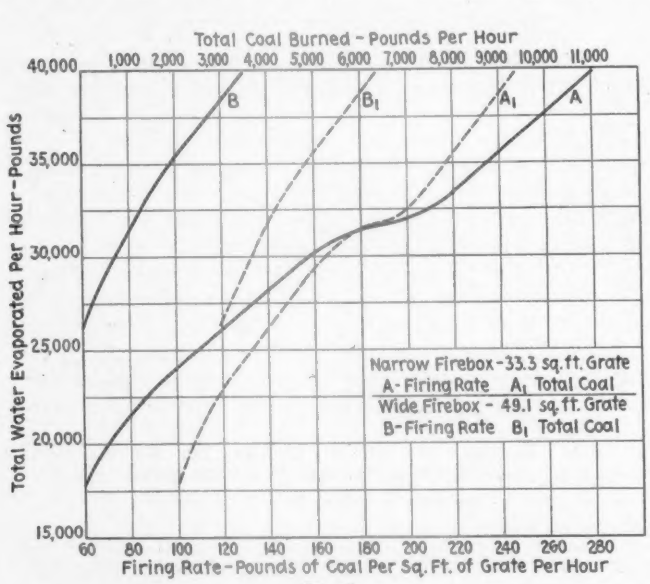


Fig. 3

tion, as given by the formula, is 7.2 lb. This agrees with Fig. 1 and, therefore, 100 and 7.2 are the correct values for the locomotive in question. If the locomotive uses superheated steam and has a value of 50 for r and 15 for e, the formula becomes $c = \frac{750}{w}$. If we assume a firing rate of 110 lb., the corresponding evaporation, as given by the formula, is 6.8 lb., whereas Fig. 1 shows an evaporation at this firing rate, of 6.5 lb. If, however, we assume a firing rate of 120 lb., the corresponding evaporation, as given by both the formula and Fig. 1, is 6.25 lb. These values should, therefore, be used.

It is evident that if the value of w corresponding to any selected value of c, as given by the formula, is less than the value given by Fig. 1, then the firing rate should be reduced in order to equalize the two; whereas, if the formula shows a higher value for w than does the curve in Fig. 1, then a higher value of c should be tried. With a little practice and with fixed values, in any given case, for r and e, the corresponding values for c and w can readily be found.

Due to differences in the values of e, two locomotives with practically the same r values may show surprising differences in the firing rates. This is illustrated in the case of the two engines considered in Table III.

Table III

Engine	Firebox heating surface in per cent of total	Values of r	e	c
A	5.35	60.5	11.6	94
B	10.90	59.8	17.3	230

Engine A is a wide firebox 4-6-2 type using saturated steam, while engine B is a 4-4-0 type of the period of 1872, with a deep firebox between frames and driving axles and tubes only half the length of those in engine A. Engine A should have no difficulty in developing horsepower as calculated by the Cook formula, but it is very problematical as to whether sufficient coal could be burned in the small firebox of engine B to make a similar performance possible.

Narrow Fireboxes

Of the heavy narrow firebox locomotives investigated, built during the nineties and early in the present century, very few were found in which the firing rate when developing full potential horsepower would be less than 200 lb. per square foot of grate per hour. The average firing rates and the values of "horsepower divided by grate area" for three representative types were found to be as shown in Table IV.

Table IV

Type of locomotive	No. of locomotives	Firing rate, average	Horsepower / Grate area
4-4-0	17	249	39.0
4-6-0	24	248	39.3
2-8-0	14	236	37.5

In a number of instances the firing rate was far in excess of 300 lb., entirely beyond the limit of the curve

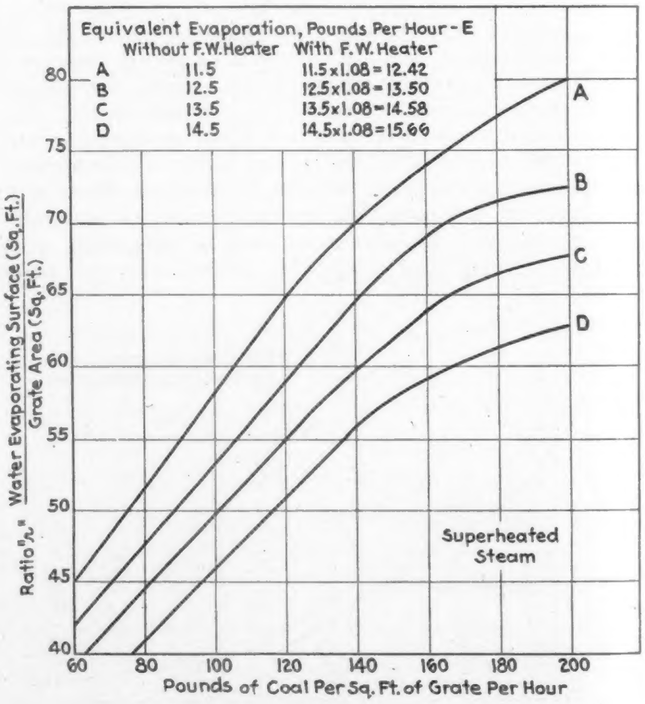


Fig. 4

shown in Fig. 1. Table V gives data covering some of these locomotives. The "potential" horsepower is that calculated from the formula, while the "probable maximum" horsepower is based on an assumed firing rate of

Table V

Engine	Type	Values of r	e	Horsepower / Grate area	Horsepower Potential	Probable maximum
C	4-4-0	90.2	15.8	50.2	940	6[illegible]0
D	4-4-0	100	15.8	53.8	985	5[illegible]5
E	4-4-0	89.5	15.4	48.3	1,220	8[illegible]5
F	4-6-0	107	15.5	57.3	1.020	5[illegible]5
G	4-6-0	96	13.9	47.5	1,445	1,0[illegible]5
H	2-8-0	103	13.7	51.5	1,895	1,2[illegible]0
I	2-8-0	99.5	13.6	48.2	1,615	1,140
J	4-8-0	93.5	14.3	48.2	1,805	1,2[illegible]5
K	4-8-0	96.5	14.4	50.2	1,705	1,165

200 lb. and an evaporation of 4¾ lb. of water per pound of coal, as taken from Fig. 1. The steam consumption per horsepower-hour is then taken from Table II.

Engines *C*, *D* and *F* had narrow fireboxes between the frames and driving axles, while the other locomotives had long fireboxes placed above the frames but between the wheels. The most abnormal case is engine *F*, in which the probable horsepower is only 57.4 per cent of the potential.

It is probably safe to say that the heating surface should not be used as a basis for horsepower calculation in any locomotive in which the firing rate exceeds 200 lb. In many locomotives it would be impossible to force the rate of combustion even to that figure. A heavy vertical line *E* in Fig. 2 divides the diagram into two parts, that on the left covering locomotives which come within the 200-lb. limit and that on the right those, including the majority with narrow fireboxes, that exceed this limit.

The wide firebox, saturated steam locomotives, show firing rates that are far more favorable. Table VI presents particulars of 75 locomotives of four types:

Table VI—Saturated Steam

Type	No. of locomotives	Values of r	e	Horsepower / Grate area	Firing rate	Weight / Horsepower
4-6-0	14	60.0	13.6	29.0	128	131
2-8-0	26	59.8	13.5	28.7	128	133
4-4-2	19	62.4	13.2	29.4	134	126
4-6-2	16	69.8	11.7	29.3	129	147

In the items given in the last column of the table the weight of each locomotive in working order, but without tender, is that considered.

There is a marked similarity in the firing rates of all four types and also in the amount of horsepower developed per square foot of grate area. The 4-6-2 type, with its long tubes, shows a considerably lower equivalent evaporation than the other three and also a higher weight per horsepower. The minimum and maximum firing rates for the different types are as shown in Table VII.

Table VII

Type	Minimum	Maximum
4-6-0	112	155
2-8-0	81	192
4-4-2	81	177
4-6-2	94	167

To illustrate more clearly the effect which the amount of grate area has on the firing rate and the evaporation, Fig. 3 is presented. The curves are based on two saturated steam locomotives built for the same road, and practically duplicates of each other, except that one had a narrow, and the other a wide, firebox. Characteristics of these locomotives are given in Table VIII.

Table VIII

Firebox	Grate area	Total heating surface, sq.ft.	Evaporation, lb. per hour (Cook)	Values of r	e	c	Horsepower / Grate area
Narrow	33.3	2,812	39,900	84.5	14.2	282	43.3
Wide	49.1	2,844	39,600	57.8	13.9	124	29.0

Although, due to the distribution of the heating surface, the maximum estimated evaporation with the narrow firebox is slightly greater than with the wide, it is very questionable whether the rate of firing in the first locomotive could be forced sufficiently to produce the evaporation called for. It is interesting to note that with a total coal consumption of (say) 5,000 lb. an hour, the wide firebox boiler evaporates 20 per cent more than the other. No wonder that the use of the wide firebox proved a relief to the fireman as well as to the railroad manager.

Superheated Locomotives

Particulars covering 125 locomotives using superheated steam are presented in Table IX. The locomotives fitted with feedwater heaters are separated from those not so equipped. In the case of the former, two rates for equivalent evaporation are given—one with the heater cut out and the other with the device in use. The increased evaporation due to using the heater is taken as eight per cent, in accordance with the Cook method of calculation. The potential horsepower is based on this higher value, but in determining the firing rate the lower value for *e* should be used.

Table IX—Superheated Steam

Type	No. of locos.	Feed-water heater	Values of r	e	Horsepower / Grate area	Firing rate	Weight / Horse-power
4-6-2	24	No	60.5	12.5	37.1	123	125
4-6-4	6	Yes	50.8	12.9 13.9	38.7	96	115
2-8-2	26	No	63.4	12.3	37.0	132	124
4-8-2	17	No	60.8	12.8	40.3	132	121
4-8-2	6	Yes	58.4	13.6 14.7	46.8	137	106
4-8-4	4	No	58.4	13.2	41.2	127	116
4-8-4	18	Yes	54.0	13.1 14.1	42.7	111	109
2-10-2	18	No	59.8	12.7	38.6	125	118
2-10-4	6	Yes	52.5	13.1 14.1	41.9	103	111

It is unfortunate that, in the case of a number of these types, there are very few representatives. Thus, the low average weight per horsepower of the 4-8-2 type locomotives with feedwater heaters is largely due to the fact that one of these designs weighs only 89.5 lb. per horsepower—the lightest, in point of weight per horsepower, of any of the locomotives investigated.

The firing rates in the locomotives covered by Table IX vary from a maximum of 78 lb. in the case of a 4-6-4 type, to 186 lb. in the case of a 2-8-2 type. Averaging the figures, the locomotives with two-wheel trailing trucks show a firing rate of 130 lb. as against 109 lb. for the locomotives with four-wheel trailing trucks—a reduction of 16 per cent in favor of the latter. Similarly, the locomotives without feedwater heaters average 121 lb. weight per horsepower as against 110 lb. for those with feedwater heaters. This represents a reduction of approximately 9 per cent.

Comparing the locomotives equipped with superheaters and feedwater heaters with the saturated steam, wide firebox locomotives previously discussed and in general use 25 years ago, the average weight per horsepower has been reduced from 134 to 110 lb., or approximately 18 per cent.

Fig. 4 shows the firing rates corresponding to different values of *r* and *e*, for locomotives using superheated steam. Each curve represents two values of *e*, depending upon whether or not a feedwater heater is used. For reasons previously explained, the maximum firing rate shown on the diagram is 200 lb. an hour.

A method of horsepower calculation, such as has been discussed, is of interest and value in comparing locomotives of different designs and in estimating the capacity of new power. It must be used wth some caution, however, especially in the case of the older narrow firebox locomotives where it is liable to give values for evaporation that are entirely beyond the capacities of the boilers.

Brakes for

Modern High Speed Trains*

By L. K. Sillcox†

Improvements made in air brakes to meet new conditions—Other possible types of train brakes are considered

NO mere increase in the physical capabilities for speed can be considered adequate to the needs for high-speed operation on the railways. Attention must be given all elements of operating practice and all details of the railway facilities which are affected by speed, foremost among which are signalling and braking. Consideration of signalling and braking are so intimately related to the speed of the units over which they must exercise control that it is impossible to deal with the problems imposed by modern and prospective train speed without giving passing thought to these vital elements without the parallel development of which, ever higher speeds could not be safely attempted.

Increased maximum train speeds have introduced the necessity for amplification of the type of brake equipment heretofore furnished and the newer designs have provided for reductions of at least 60 per cent in the length of stops from ultra high speeds.

Adhesion Between Wheel and Rail

As a wheel rolls freely upon a rail, there is no relative movement between wheel and rail at the point of contact. In fact, the wheel occupies a minute depression in the rail since, under normal wheels loads, there is a measurable distortion of both wheel and rail. Since the wheel-rail contact is normally static, the same frictional resistance to rotation of car wheels is required throughout the entire speed range to induce them to slide upon a dry rail.

It is a simple matter to measure the coefficient of wheel-rail adhesion when the wheel is at rest, the coefficient of wheel-rail adhesion being defined as the factor which, multiplied by the weight upon the wheel, defines the force applied tangent to the wheel at the point of contact, which resists movement of the wheel along the track without rotation. It is more difficult to determine its values as speed increases since many variables are introduced by conditions of weight transfer imposed by imperfect track surface, the interaction of different parts of the equipment, the effect of lateral forces imposed by guiding, and the vertical oscillation of car bodies and other sprung weights upon the yielding suspension system. Since it is impracticable to attempt to measure the instantaneous values of these variable forces or their resultant, the adhesion coefficient can best be determined by obtaining the average of results of repeated trials. Tests have now been conducted which verify the maintenance of the static value of approximately 0.25 under dry rail conditions for the coefficient, independent of speed. Although the behavior of this single factor with increasing speed has been established as constant, it is the product of the weight supported and the coefficient of wheel-rail adhesion which resists wheel sliding and, as speed increases, the influence of irregularities in the surface of the track increases in like proportion to the end that, upon encountering any slight obstruction, the vertical acceleration of the wheel and car body is higher with a greater momentary wheel load, and a subsequent greater reduction in the weight supported. During this brief interval a high brake retarding force may decrease the rate of rotation, causing slipping of the wheel upon the rail and, once started, a condition of sliding can be continued with a lower wheel retarding force than otherwise since, after slipping occurs, the coefficient of wheel-rail adhesion is no longer static but kinetic and if rotation is arrested, the coefficient of brake shoe friction is no longer kinetic but assumes its higher static value. For this reason, the surface of track over which heavily braked, high-speed trains operate must be carefully maintained and the spring suspension system arranged to insure, as far as possible, a uniform and constant load upon the rails.

Brake-Shoe Friction

There is another very important phenomenon to be considered in any enlightened approach to the problem of high-speed braking. While tests have proved the existence of a constant coefficient of wheel-rail adhesion, the variable nature of the kinetic coefficient of brake-shoe friction has also been established. Its value decreases as brake-shoe pressure increases and is further diminished with each increment of speed increase. In view of these facts, it has been customary to so limit the maximum brake-shoe pressure that the friction developed at low speed should not be sufficient to cause injurious wheel sliding. The total friction at any instant is the direct measure of the resistance which is then retarding the motion of the train and, therefore, a uniform brake-shoe pressure offers much less resistance to the motion of a high-speed train at the beginning of a stop than at the subsequent low speed. It is for this reason that a greater brake-shoe pressure may be applied to the wheels at high speed than at lower rates of travelling without causing them to slide. This has been the principle respected in the formulating of all high-speed brake designs.

Types of High Speed Brakes

The first approach to this variable shoe pressure problem obtained a diminishing brake-shoe pressure value as the retardation cycle progressed by the use of a reducing valve, adjusted to relieve brake-cylinder pressure at a predetermined rate, whereas the more modern basis has been that of using an inertia governor, not subject to any time element but responsive only to the longitudinal inertia effect of the train when being brought to a stop.

The brake which was fitted with a high-speed reducing valve was essentially a quick-action air brake operating under high pressure. In emergency applications it first created a high brake-cylinder pressure and this was gradually and automatically reduced as the speed de-

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creased. This scheme offered no selection of change in brake cylinder pressure with initial speed or other conditions which might affect the stop and did not permit utilization of maximum retarding force at any time. Obviously, since the coefficient of brake-shoe friction varies in a very definite and reliable manner with the rubbing speed of the brake shoe over the wheel tread, an attachment at the axle to measure the change in the factor causing variation in retarding force could be the only practicable alternative for the inertia principle which measures the effect of brake-shoe friction variation and automatically adjusts the mechanism to preserve the effect at a predetermined level. The control device employed consists of a housing within which a heavy weight is mounted in such a maner that it is permitted displacement in the direction of car movement. With its movement from normal position resisted by carefully calibrated springs, a force of known intensity will change its position by a predetermined amount. Upon initiation of a brake application, the brake cylinders of the car, the retardation of which is under the automatic control of this device, will receive pressure, extending the pistons and pressing the brake shoes against the wheels. A rate of retardation is thus impressed upon the car which, if of sufficient magnitude to cause the weight to thrust forward against the opposing forces of the springs, brings the retardation-control device into action. The function of the weight is that of operating a valve or, indirectly, a circuit which gradually releases pressure from the brake cylinder if the rate of retardation attains a selected maximum. This rate, fixed by the factor of wheel-rail adhesion, cannot be exceeded without introducing the hazard of wheel sliding.

Limits to Retardation Obtainable

If the weight upon the wheels were constant at all times and rail conditions were always the same, the wheel-rail adhesion factor of 0.25 could be utilized to obtain a maximum rate of retardation. Since retardation is negative acceleration, the fundamental equation,

$$F = M\,a$$

can be used for determining the maximum rate of retardation which may be impressed. In the above equation,

F = retarding force in pounds
M = mass
a = rate of acceleration in feet per second per second

since

$$M = \frac{W}{g}$$

W = weight in pounds
g = acceleration due to gravity = 32.2 ft. per sec. per second,

the equation may be written

$$F = \frac{W\,a}{32.2}$$

Then, to determine the maximum permissible rate of retardation, *a*, which may be impressed with security from wheel sliding with coefficient of wheel-rail adhesion of 0.25,

$$a = \frac{32.2\,F}{W}$$

With the weight, *W*, taken as unity, the equation reduces to,

$$a = 32.2 \times 0.25 = 8.05 \text{ ft. per sec. per sec., or } 5.50 \text{ m.p.h. per sec.}$$

Actually, a factor of 0.25 may not be available in every case or the weight on any axle may be momentarily relieved. In the interest of security from possible damage to the wheels, a coefficient of 0.16 is selected on no other basis than that of judgment governed by experience in high speed braking. The maximum retardation rate is then,

$$a = 32.2 \times 0.16 = 5.15 \text{ ft. per sec. per sec., or } 3.50 \text{ m.p.h. per sec.}$$

To the average railway mechanical officer, a suggested sustained retardation rate of 3.5 m.p.h. per sec., obtainable by the use of the pneumatic brake alone, would seem too optimistic to be seriously considered even though he is seeking a reduction in the minimum stopping distances to conform with the needs of the operating department. His hesitancy is due to a fear that the attempt to secure such a marked improvement, providing the stopping distances tabulated below, would be attended by undesirable features to the extent that the advantage of minimum stops would be more than offset by difficulties in other direction.

Stopping Distances Obtainable with a Retardation Rate of 3.5 M.p.H. per Sec., Sustained throughout the Duration of Stop. (Average Speed=55 per cent Initial Speed).

Initial speed, m.p.h.	Stopping distance, ft.
100	2,300
90	1,870
80	1,470
70	1,130
60	830

If trunk-line railway speeds must be increased in any case beyond the point that stops effected with a 3.5 m.p.h. per sec. retardation rate are no longer satisfactory or do not fall within the limits imposed by signal spacing in localities where relocation would be particularly costly or would cause undue occupation of track by prevailing slower moving trains, or if any combination of circumstances arises which demands a still higher retardation rate than can be obtained by the use of the pneumatic brake alone within the limits of wheel-rail adhesion, some supplementary braking method must be adopted.

When a source of ample electrical energy supply is available, as when electric traction is employed, magnetic track brakes are suggested. If this is impractical or inadequate and if very high speeds are practiced, there are opportunities for shorter stopping distances presented by a wind resistance brake, an unproven expedient in-so-far as service tests are concerned but one which, producing the effect of increasing head-end air resistance, will be most effective in the early stages of a brake application from high speeds, offering a positive retarding force, independent of wheel-rail adhesion, which is subject to reasonable mathematical evaluation.

Magnetic Track Brakes

The magnetic track brake is less effective than is generally believed and its use entails features which render its application impracticable in many cases. When car equipment is light, traffic congestion serious, demanding maximum acceleration and deceleration rates, and an unlimited supply of electrical energy available, all of which are conditions common to the multiple-unit trains of important subway lines where the track brake has been most highly developed, the opportunities for justifying its cost, weight, and maintenance are much more favorable than on trunk-line railways.

In any consideration of a magnetic track brake, several important factors must be recognized. First, to obtain an efficient track brake with predictable characteristics, perfect contact between rail and shoe must be obtained, it having been demonstrated that a 21 per cent reduction in shoe-rail pressure results from the introduction of an air gap of but 0.0156 in. Perfect contact is impossible to maintain in railway work where both the gap and

force are widely variable. Second, the use of a track brake makes the use of sand impracticable since the abrasive action of a sanded rail introduces excessive wear on the shoes and, by wiping most of the sand off the rail, the shoes limit the permissible braking ratio which may be employed in connection with the wheel brake. Third, it is generally impossible to install sufficient length of track shoe, by reason of clearances between truck wheels, to provide a really effective track brake on any main-line railway equipment constructed to date. Fourth, the cost and weight of equipment required, including battery and generator, are disproportionately high. Fifth, there is no background of experience to define the measure of safety involved in thrusting track shoes upon the rails in front of wheels of units moving at high, main-line speeds.

A typical magnetic track brake shoe will exert a pull of approximately 300 lb. per inch of shoe length on a 130-lb. rail whenever perfect contact is obtainable throughout its length. This is obtained with an energy consumption of 50 watts per inch. Although unpredictable in view of the meagre data available, it is improbable that instantaneous contact conditions will provide more than 75 per cent of the vertical pull obtainable under conditions of perfect contact. This would mean a unit pressure of not more than 225 lb. per linear inch. If 60 in. of track shoe are installed per truck (120 in. per car or 720 in. per six-car train), the total pressure would be 162,000 lb. The coefficient of friction between track shoe and rail will probably seldom exceed a value of 0.07 throughout a stop from 90 m.p.h., in view of the very high unit pressure which may result from an equivalent magnetic attraction of 300 lb. per linear inch. It is further indicated that instantaneous values of 100 m.p.h. do not exceed 0.02. Assuming an average value of 0.07 throughout the stop from 90 m.p.h., the retarding force derived would be 11,345 lb. for the entire train. A retarding force of this order, however secured, is but 12 per cent of that obtained by the use of a standard pneumatic brake for conventional equipment, presenting a maximum emergency braking ratio of 150 per cent which, unassisted by an auxiliary brake, will provide an average retardation rate throughout the stop of 2 m.p.h. per second. Were a 3.5-m.p.h. deceleration rate impressed by a pneumatic brake, electrically operated to accelerate the response of the individual valves and with retardation rate automatically controlled, the effectiveness of the track brake would be but seven per cent of that of the pneumatic system. Furthermore, with an energy input of 50 watts per inch of shoe, or 6,000 watts per car, the current consumption, with a 32-volt system, will be at the rate of approximately 87 amp., requiring not less than 1,000 amp. hr. of battery capacity per car for all trains which do not derive their energy from a central source, remote from the train. Adding to the weight and cost of this battery the weight and cost of the generator required to serve it in the event that the train is not electrically propelled, and that of the mechanism itself which will add not less than 600 lb. per truck, the advantage to be gained will generally be more than offset by the cost involved and the extra weight required.

The Wind Brakes

The wind brake may be defined as an unexplored medium which may be properly employed in the control of trains operating at high speeds. It utilizes the air resistance force which modern high-speed trains are designed to reduce to a minimum. Head-end streamlining of a conventional steam locomotive can, by proper application as developed by model tests conducted by the National Research Council, reduce the coefficient of head-end resistance (K_a in the equation, $R_a = K_a AV^2$) from 0.0024 to 0.0015, where

Ra = head-end air resistance in pounds
Ka = coefficient of head-end air resistance
A = frontal area in square feet
V = speed in m.p.h.

The projected frontal area of a passenger-train car of conventional proportions is approximately 124 sq. ft. This will produce an air resistance force if streamlined to the extent that $K_a = 0.0015$, of 0.18525 V^2. If it were possible to present the equivalent of a flat surface of 160 sq. ft., nearly the maximum as defined by the A.A.R. clearance lines, normal to the direction of motion, to assist in decelerating from high speeds, the head-end resistance would be defined by the expression:

$$Ra = 0.00324 \times 160 \ V^2 = 0.518 \ V^2$$

Then, when $V = 90$ m.p.h., the comparative resistances are:

Streamlined car = 1,500 lb.
Flat Plate (160 sq. ft.) = 4,200 lb.

The difference, or 2,700 lb., would be available to assist in retarding the train by virtue of the provision of vanes which would take advantage of the potential force available in the air.

While it is not possible to anticipate the utilization of the entire clearance diagram for effective area to be presented to wind effects, there is nothing to limit the number of such collapsible vanes advantageously located along the train, operated pneumatically and automatically upon each emergency brake application, and receding into the car structure or folding back into recesses in the car sides, maintaining an unbroken surface contour when not in use. If retractable vanes were fitted to the front of the leading car of a streamlined, multiple-unit train, providing an equivalent flat plate area of 140 sq. ft. with a vane of 25 sq. ft. projected area fitted at the rear of each car, assuming that the vanes at the car ends offer a unit resistance equivalent to the head-end value, there will be offered the equivalent of 290 sq. ft. frontal area. This is probably too high a value to be used in view of the interference caused by successive interruptions of the air stream and a better value for estimate may be 250 sq. ft.

The resistance offered will be,

$$0.00324 \times 250 \ V^2 = 0.810 \ V^2$$

and the added resistance to motion of the train will be,

$$(0.810 - 0.185) \ V^2 = 0.625 \ V^2$$

The effect of this force at various speeds of traveling is given in the table.

Resistance Introduced by Wind Brakes

Speed m.p.h.	Added resistance afforded by wind brake, lb.
90	5,060
80	4,000
70	3,060
60	2,250
50	1,560
40	1,000
30	560

Since the kinetic energy possessed by a moving train varies with the square of its speed, as does the resistance due to the wind brake, such a brake is especially desirable to be used in conjunction with the conventional air brake. From speeds of 40 m.p.h. to stop, it is not difficult to obtain by the use of the conventional air brake alone all the retarding force which can be safely impressed. At the higher speeds, when the coefficient of friction is materially reduced in value, the wind brake affords a practical means for supplementing the dimin-

ished retarding effect. The exact benefit that can be expected from the use of a wind brake such as that described, in the way of decreased stopping distance, is not immediately predictable. Its effect is dependent largely upon the measure of increase of car cross section, upon the degree of streamlining practiced, the weight of the train, and the speed of operation.

Air Brakes Adequate for Present Needs

Whatever expedient has been yet tried or suggested to increase the available rate of retardation from high speed beyond that obtainable with pneumatic brakes, electrically operated for simultaneous response throughout a train of coupled cars, none is offered which assumes the importance of the highly developed air brake which must be relied upon to form the basic retarding medium under all circumstances. The time has not yet arrived when the capacity of the air brake places a definite limitation upon the maximum speed which may be practiced, even upon well constructed and maintained track, fitted with heavy rail sections and with curves of large radii, on which the outer rail is properly elevated. The maximum retardation rate of 3.5 m.p.h. per sec., obtainable by retarding the rotation of the wheels, is not yet utilized, due in part to imperfect rail surface, in part to inadequate control of weight transfer, and in part to the hesitancy of railway administrations to attempt radical innovations in practice, no matter how desirable it may be to accomplish the purpose for which they are designed. The increase to the maximum rate will be cautiously pursued and retardation rates will advance little by little as they have in the past, with associated improvements installed to insure protection against possible discomfort within the trains and damage to wheels. Effective and positive sanding of the rails at various points throughout the length of the train is required to insure the attainment of the minimum coefficient of wheel-rail adhesion of 0.16, irrespective of rail condition, since this value must be sustained if the maximum rate of retardation is to be obtained with security.

Effect of

Natural Winds on Air Drag

By George W. DeBell

Derivation of conversion formulae and presentation of curves of increase in the drag of passenger trains, operating at constant speed, caused by natural winds

In actual operation we are interested in the increase in air drag, at constant train speed, due to natural winds. The magnitude of this increase may be derived from wind-tunnel tests of the train at various angles of yaw, but the determination entails considerable mathematical computation. It is the purpose of this article to present the derivation of the conversion formulae and show curves of drag increase with natural winds, at constant train speed, for streamline power-car trains, streamline locomotive trains, and conventional steam trains.

The wind tunnel tests upon which these curves are based, were made in the New York University wind tunnel by the American Car and Foundry Company, the American Locomotive Company, and The J. G. Brill Company, cooperatively.* The tests included tests of trains of various lengths as well as of different contours. The models used in the yaw or quartering wind

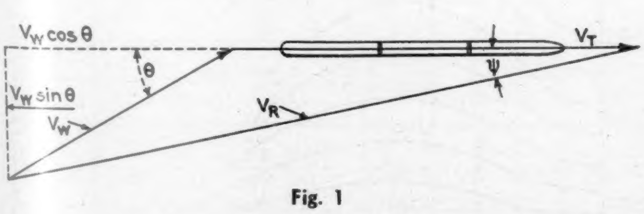


Fig. 1

tests were all made to a scale of 1-32 of full size and were in as complete detail as could be represented at this scale.

During the wind tunnel tests the air velocity was maintained constant and, therefore, the ratio of the drag at yaw angle to the drag at zero yaw, as obtained from these tests, is based on a constant resultant air speed and not on a constant train speed. Since we are really interested in the ratio at constant train speed we must compute new ratios based on the natural wind velocity and direction and the drag ratios from the wind-tunnel tests.

It will be noted that in deriving the formulae for computing this revised ratio we have assumed that the air drag varies as the square of the velocity. This may be done without appreciable error, as, in the yaw condition, most of the drag is pressure or vortex which is proportional to the square of the velocity. It may be well to mention here, that, in this article, the word "drag" refers to the air force component which is parallel to the track and, therefore, directly affects the train resistance:

Let

V_w = velocity of natural wind
V_t = velocity of train
V_r = velocity of resultant wind
θ = angle between natural wind and track
For head wind, $\theta = 0°$
For tail wind, $\theta = 180°$

$r = \dfrac{V_w}{V_t}$ ratio of natural wind velocity to train velocity

Ψ = angle of yaw = angle between resultant wind and track
R_r = ratio of drag at angle of yaw Ψ to drag at zero yaw, based on constant resultant wind speed.
(Obtained from wind tunnel tests)

* For a general description of these tests see the *Railway Mechanical Engineer* for December, 1935, page 496.

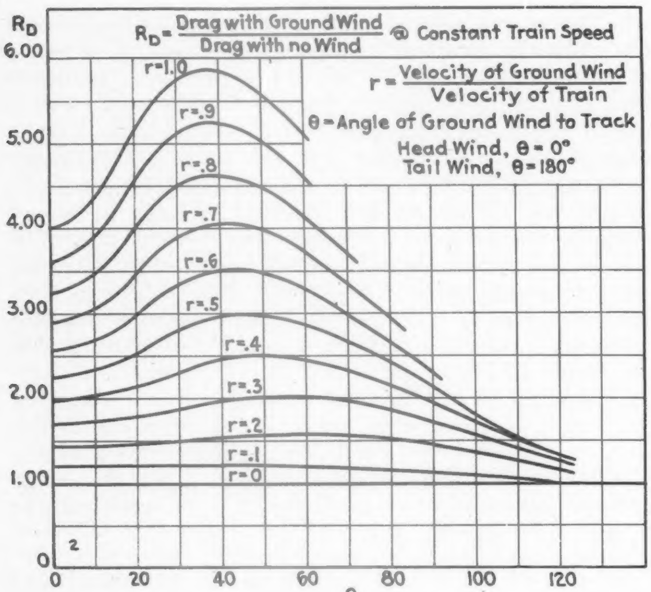


Fig. 2—Increase in drag, due to ground winds, at constant train speed—Power-car train with open skirts

R_d = ratio of drag with natural wind to drag with no wind (still air), based on constant train speed.

Then

$$V_r^2 = V_w^2 \sin^2\theta + (V_t + V_w \cos\theta)^2 = r^2V_t^2 \sin^2\theta + V_t^2(1+r\cos\theta)^2 = V_t^2(r^2\sin^2\theta + 1 + 2r\cos\theta + r^2\cos^2\theta) = V_t^2(r^2 + 2r\cos\theta + 1)$$

Or

$$\frac{V_r^2}{V_t^2} = r^2 + 2r\cos\theta + 1$$

But

(Drag at angle Ψ and wind velocity V_r) =

(Drag at zero yaw and V_t) $\times R_r \times \frac{V_r^2}{V_t^2}$ = (Drag at zero yaw and V_t) $\times R_d$

Therefore

$$R_d = R_r \times \frac{V_r^2}{V_t^2} = R_r \times (r^2 + 2r\cos\theta + 1)$$

Also

$$\Psi = \tan^{-1}\frac{V_w \sin\theta}{V_t + V_w\cos\theta} = \tan^{-1}\frac{rV_t\sin\theta}{V_t + rV_t\cos\theta} = \tan^{-1}\frac{r\sin\theta}{1 + r\cos\theta}$$

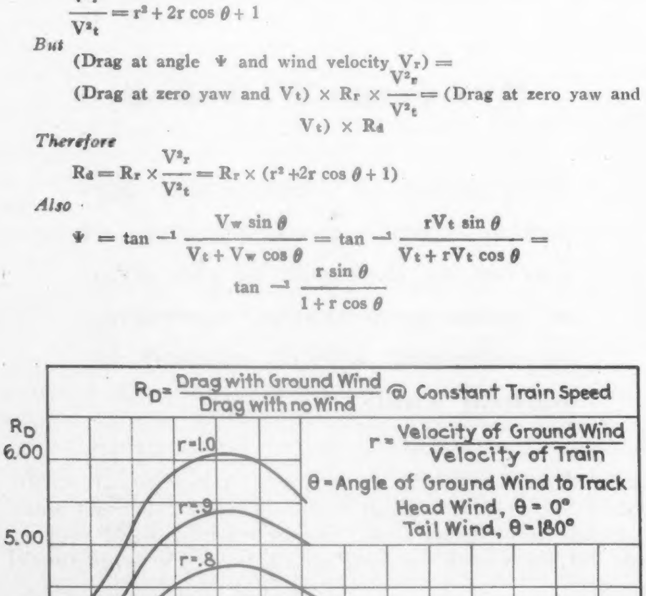


Fig. 3—Increase in drag, due to ground winds, at constant train speed—Power-car train with closed skirts

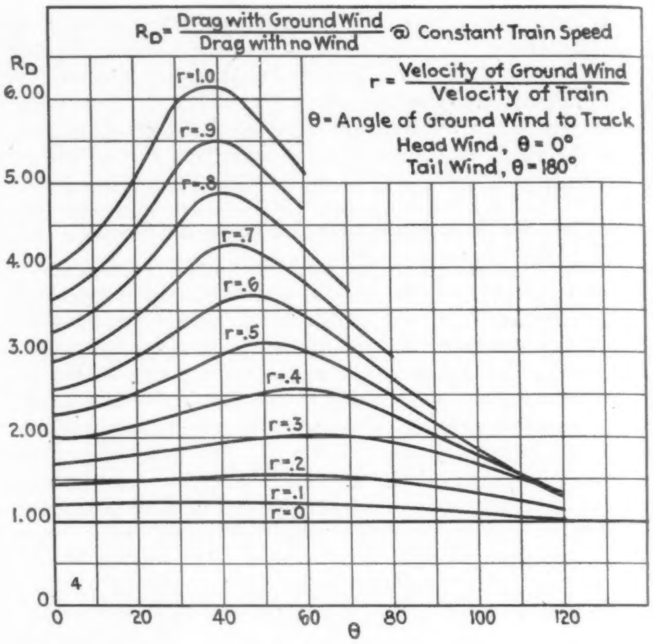


Fig. 4—Increase in drag, due to ground winds, at constant train speed—Streamline locomotive and trail car

The values of R_d have been computed for all the models which we tested in our wind-tunnel program and the results of these computations are plotted in Figs. 2, 3, 4 and 5.

Fig. 2 applies to the power-car trains with open skirts. Fig. 3 applies to the power-car trains with closed skirts, Fig. 4 to the streamline locomotive trains, and Fig. 5 to the standard New York Central trains.

It will be noticed that these figures do not show any variation with the length of train. This is substantially correct as the preliminary plots of the R_r ratio, which were made from the wind tunnel results for each length of train, showed the curves to be interlocking and therefore, the average curve was used in computing the above mentioned figures. This eliminated the effect of train length.

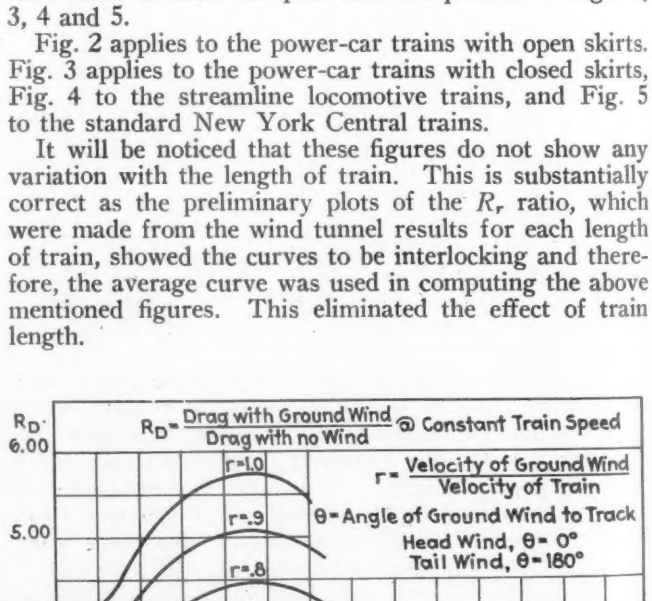


Fig. 5—Increase in drag, due to ground winds, at constant train speed—Conventional New York Central train

It is our belief that the use of the average curve does not affect the ratio by more than 10 per cent and this is negligible since in actual service the natural wind conditions are constantly varying.

In the above mentioned figures it will be noted that R_d has been plotted against the angle of natural wind, θ, with parameters of r, the ratio of natural wind velocity

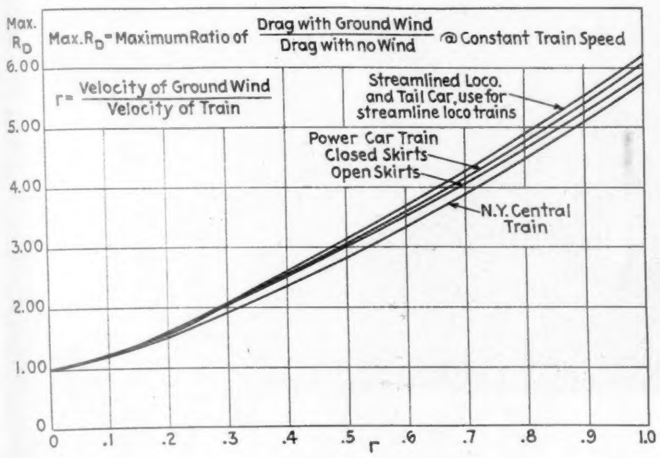


Fig. 6—Maximum increase in drag, due to various ground wind velocities, at constant train speed

to train velocity. It is interesting to note that the maximum value of R_d practically always occurs at a value of θ approximately 40 deg. to 50 deg, regardless of the type of train.

Since, in actual practice, the direction of the natural wind is seldom known, it is safest when applying these figures to use the highest value of R_d applying to the known velocity ratio, r. This has been done in Fig. 6 which shows the maximum value of R_d versus the ratio of the natural wind velocity to train velocity for the different types of trains. Where the angle of the natural wind is unknown or questionable it is therefore suggested that Fig. 6 be used.

Using the values of R_d as taken from the above mentioned figures the drag of a train under the influence of a natural wind may be computed by selecting the proper value of R_d and multiplying it by the drag of the train in still air.

Expressed in equation form:

Where:

D_w = the air drag of the train under the influence of a natural wind V_w.

D_o = the air drag of the train in still air at a train speed of V_t.

R_d = factor as obtained from charts.

$D_w = R_d \times {}_o$.

In actual service some allowance for average wind conditions should be made if a higher value of on-time performance is to be maintained. This can readily be seen from Fig. 6 which shows that a natural wind of one-third of the train speed may more than double the air drag and that a natural wind of one-fifth of the train speed may increase the air drag by more than 50 per cent. In a majority of cases the exact magnitude and direction of the wind varies and, therefore, we must resort to averages in order to make wind allowances. At the present time, for want of more accurate information, we suggest that the year round average wind velocity for the particular locality of the run be used, and that the wind be assumed always to come from the worst direction. Then having determined the average wind velocity, we can find the drag increase ratio by referring to Fig. 6.

After we have had more experience in the operation of streamlined trains, we will undoubtedly be able to arrive at a closer approximation of the actual average wind, but at the present time in order to make some allowance for the effect of natural winds we must rely upon information obtained from the Government Weather Bureau, from whom we can get the year round average winds. Later we may find that we should apply a correction factor to these average winds in order to obtain a more accurate working value for performance estimation, but, as we have previously mentioned, the derivation of this factor will depend upon the data obtained from actual operation of streamlined equipment.

In conclusion, an inspection of Fig. 6 will show that streamlined equipment has a greater percentage increase in air drag with natural winds than does standard equipment. This is natural since as the angle of the resultant wind to the centerline of the train becomes greater the value of the streamlining becomes less pronounced until when the resultant wind hits the train at an angle of 90 deg. the value of the streamlining is small. However, due to the much lower resistance of the streamlined equipment at zero yaw, the air drag of the streamlined equipment, even with the most adverse natural wind, is still much less than that of the equivalent conventional equipment.

Diesel-Electric Freight Locomotive

A 1,600-hp. 133-ton Diesel-electric locomotive has been completed by the Westinghouse Electric & Manufacturing Company. The specifications drawn up before the locomotive was built required that the total weight be carried on four driving axles, that the mechanical features be sufficiently simple and durable to meet the most severe freight-service requirements, that all ordinary maintenance of power plant and auxiliary apparatus could be carried out without dismantling the cab structure, and that the unit be suitable for one-man operation.

The locomotive consists of a visibility-type cab and two equipment hoods mounted on an integral cast-steel underframe, carried on two four-wheel, swivel-type trucks. The centrally located operator's cab has its floor and roof raised above the levels of the main floor and hood roofs, respectively, and is built to a width exceeding that of the equipment hoods and supporting underframe, which, with suitably arranged windows, provides for visibility both over and along the sides of the equipment hoods. The operator's cab and equipment hoods are streamlined to a degree sufficient to avoid the box car appearance frequently found in units of this type. A Diesel power plant with its auxiliary equipment is housed in each of the equipment hoods.

The underframe incorporates storage reservoirs for fuel and lubricating oil, mounting rails for the engines and generators, air ducts for traction-motor ventilation, truck center plates, cab side bearings and bolsters, draft-gear housings, four sand boxes and push-pole pockets.

The trucks have integral cast-steel frames, side equalization with semi-elliptic springs, clasp brakes, carbon-steel axles, A.A.R. boxes and brasses with 8-in. by 14-in. journals and rolled-steel wheels. All wearing surfaces on the truck frame and underframe are protected with hardened-steel plates and holes for brake-hanger pins are bushed. Truck and underframe center plates are likewise bushed with hardened-steel bushings.

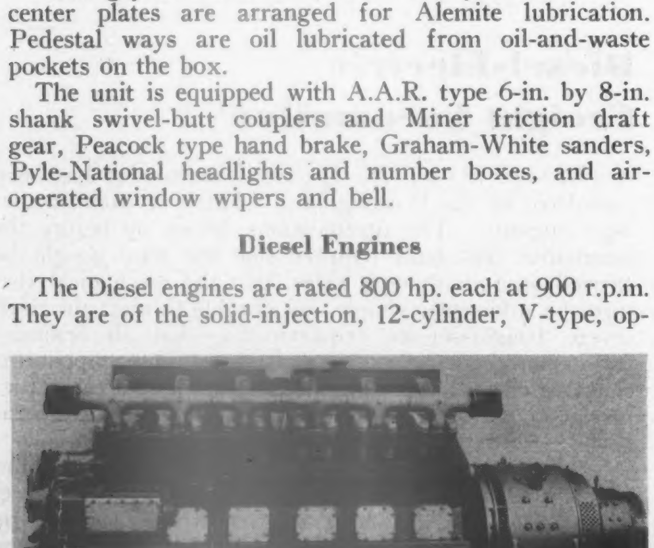
The Westinghouse 1,600-hp. Diesel - electric locomotive for freight service

Driving journals are oil lubricated and hub liners and center plates are arranged for Alemite lubrication. Pedestal ways are oil lubricated from oil-and-waste pockets on the box.

The unit is equipped with A.A.R. type 6-in. by 8-in. shank swivel-butt couplers and Miner friction draft gear, Peacock type hand brake, Graham-White sanders, Pyle-National headlights and number boxes, and air-operated window wipers and bell.

Diesel Engines

The Diesel engines are rated 800 hp. each at 900 r.p.m. They are of the solid-injection, 12-cylinder, V-type, op-



One of the 12-cylinder, V-type, 800-hp. Diesel engines

erating on the four-stroke cycle. They have integral cast-steel crankcases which are machined for cylinder liners and heads, main bearings, cam-shaft bearings, gear case and fuel pump mountings and inspection cover plates. All engine auxiliaries, such as main fuel pump, water pumps, lubricating-oil pressure and scavenging pumps, governor oil pump and cam shafts, are driven by gears at the front end of the crank case.

Removable liners of nickel cast iron are fitted in the crank case. Each cylinder is provided with an individual cylinder head, cast from aluminum alloy with steel valve seats for dual inlet and exhaust valves. The pistons are made from an aluminum alloy and machined for pressure and oil-control rings.

The fuel injection system consists essentially of a motor-driven gear pump, taking fuel oil from the main reservoir and delivering it through strainers to the main fuel-pump headers, at a pressure of approximately 30 lb. per sq. in. A main fuel-pump assembly, consisting of six units, is mounted on each side of the crank case serving the six adjacent cylinders.

Electrical Transmission

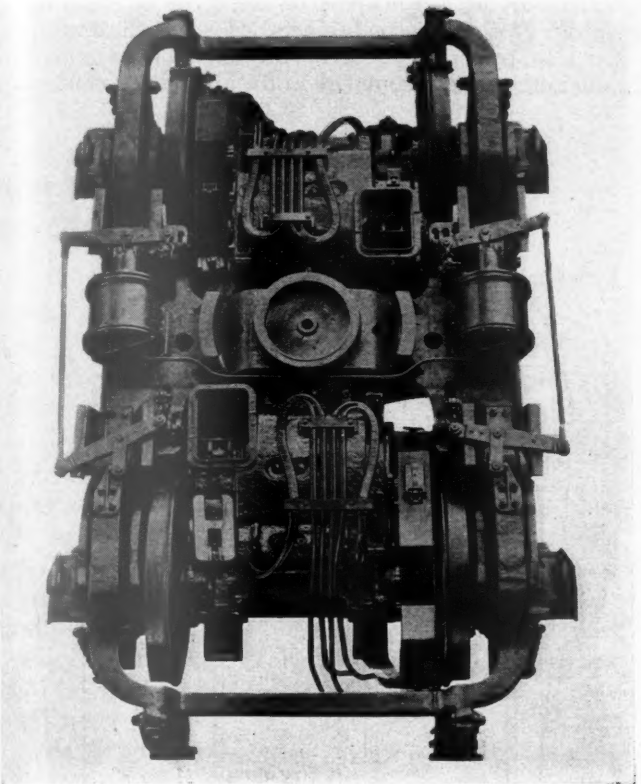
Each power plant has a single-bearing main generator which converts the mechanical power at the engine shaft to electrical energy for use by the traction motors.

An auxiliary generator is mounted on each of the main-generator bearing brackets, with its armature on an extension of the main generator shaft. A fan, mounted on each engine flywheel, draws air through the main and auxiliary generators, cooling both machines. The main generators are used as motors for cranking the Diesel engines during starting.

Four traction motors, utilizing the electrical power furnished by the main generators supply the propelling force for the locomotive. One motor is geared to each of the driving axles through a pinion on the motor shaft and a gear on the driving axle. The gearing is a spur type, machined from steel forgings and heat treated. The traction motors are of the direct-current series type, force ventilated and equipped with roller-type armature bearings and split-sleeve type axle bearings.

Control and Brake Equipment

The locomotive is equipped with Westinghouse standard dual control, developed especially for Diesel-electric locomotives to provide maximum flexibility with one-man operation. Pedestal-type controllers and brake-valve operators are located at each of the operating stations. Their shafts extend through the cab floor, and are inter-connected with sprocket gears and chains. A standard K14 brake valve, minus the handles, is located directly below one of the brake-valve operating pedestals with their corresponding shafts connected together. Westinghouse modified schedule 14-EL air-brake equipment with quick application and release feature is used. Two single-stage, two-cylinder, water-cooled air compressors, each having 120 cu. ft. displacement, driven by a 115-volt, direct-current, series motor, furnishes air for the operation at the brakes and electro-pneumatic control equipment. Both compressors and motors are equipped with ball bearings.



A view of the truck showing the arrangement of the motors and brake equipment

Two 14-in. by 10-in. brake cylinders are mounted on each truck, one cylinder being connected to the brake rigging on each side of the truck. An auxiliary hand brake is connected to one truck for holding the light locomotive at standstill.

Engine loading is controlled over the range of generator voltage and current by the Westinghouse torque-control system. Meter and gage panels, located at each operator's station, include meters for indicating main generator amperes, battery amperes, engine jacket water and oil temperatures, and air-brake gages.

The initial starting of each engine is controlled from positions adjacent to the respective engines. Starting and stopping of each engine may be controlled from the operator's station by electro-pneumatic mechanisms after main-reservoir air pressure has been pumped up. The starting battery consists of a 50-cell, Exide Ironclad battery having 15 plates per cell.

The control is arranged for the operation of all traction motors from either power plant, with the second power plant non-operative.

Foot-operated push buttons are located, one at each operator's station, for controlling weight-transfer compensating switches to permit working all drivers at maximum adhesion when the greatest starting tractive effort is required.

General Characteristics

Starting tractive force at 30 per cent adhesion	80,000 lb.
Tractive force at continuous rating of traction motors	32,000 lb.
Speed at continuous rating of traction motors	15.6 m.p.h.
Maximum operating speed	50 m.p.h.
Minimum radius of curvature:	
Locomotive alone	85 ft.
Locomotive with load	175 ft.
Length inside coupler knuckles	52 ft. 11 in.
Length over operator's cab and hoods	49 ft. 8 in.
Overall width	10 ft. 2 in.
Heights from Rail:	
Overall (at operator's cab)	14 ft. 1 in.
Over hoods (at coupler ends)	11 ft. 8 in.
Truck center distance	27 ft. 0 in.
Truck wheel base	8 ft. 6 in.
Wheel diameter	44 in.
Capacity of fuel oil reservoir	1,000 gal.
Capacity of sand boxes	5,000 gal.
Capacity of jacket water system per engine	210 gal.
Capacity of lubricating oil reservoirs per engine	85 gal.

Who Names Cars?—Much has been written in lighter vein regarding the naming of Pullman cars. However, this department's entry for the most peculiarly-named car is the Canadian National parlor car operating between Montreal and Portland, which rejoices in the name Batchewaung.

* * *

Special insulated car—A. A. R. Class RC—built by the American Car and Foundry Company for transporting 30 tons of dry ice in 55-lb. cakes. Lower half of car consists of a series of heavily insulated bins

Stack Arrangement on N. P. 4-8-4 Type Locomotives

A novel and interesting design of smokestack was employed on the latest 4-8-4 type passenger locomotives built for the Northern Pacific by the Baldwin Locomotive Works, a general description of which was given in the *Railway Mechanical Engineer*, December, 1934. These large locomotives, known as Class A2 and numbered 2,650 to 2,659, inclusive, weigh 489,400 lb., have a rated tractive force of 69,800 lb., 28-in by 31-in., cylinders, carry 260 lb. boiler pressure, have 4,964 sq. ft. of evaporative heating surface and a grate area of 115 sq. ft.—fuel being Rosebud lignite coal.

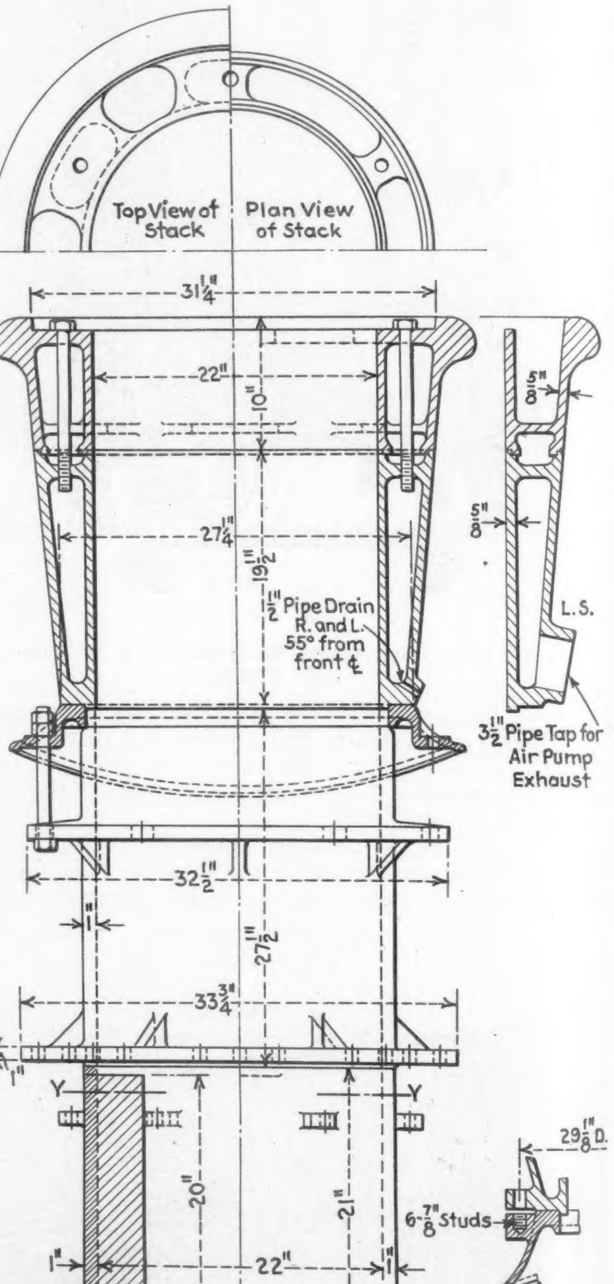
The smokestack arrangement was worked out by the railroad to meet the conditions obtaining on its line. The stack has the unusual height of 17 ft. 2 in., above the rail. The center line of the boiler is 10 ft. 8 in. above the rail; the diameter of the smokebox is 88 in.; the stack is set 76 in. ahead of the front tube sheet and 66¹⁄₁₆ in. back of the smokebox front-end casting. The main purpose of this unusually high stack is to prevent as much as possible the trailing of smoke and steam around the dome and cab which would interfere with the view of the enginemen, when the locomotive is operated with a light throttle or is drifting down grade. It is reported that the arrangement has proved highly effective in overcoming this trouble.

The top portion of the stack is a removable extension casting, 10 in. in height, which is held on by six ⅞-in. tap bolts equally spaced on a 26½-in. diameter circle. This top can thus be easily taken off when the locomotive is to be operated in a territory where tunnels or clearance restrictions require a reduction in stack height to 16 ft. 4 in.

The stack, which is of the straight type with an internal diameter of 22 in. and a total height of 6 ft. 6¼ in., is made up of five castings—top, stack proper, base, sub-base and extension. The base is a steel casting; the other portions are cast iron. The bottom extension terminates in a small bell, ¼ in. below the center line of the smokebox and approximately 13 in. above the top of the exhaust nozzle. This portion of the stack has three chilled veins 3 in. high.

The stack is attached to the base by six ⅞-in. studs on a 29⅛-in. diameter circle and the base to the smokebox by six ⅞-in. bolts on a 32⅛-in. diameter circle. After the base has been bolted in place it is welded all the way around to add to the security of the attachment and to assure an airtight joint. Six ⅞-in. bolts on a 30-in. diameter circle attach the subbase to the base and six ¾-in. bolts on a 26-in. diameter circle serve as attachment for the lower extension. The flange on the bottom of the sub-base is a wide one and, in addition to supporting the lower extension, has 16 holes for ¾-in. bolts on a 31-¾-in. diameter circle for holding the Cyclone front-end Type A spark arrester with which these locomotives are equipped.

An unusual feature in the design of this stack is the provision of an annular space between inner and outer walls into which the exhaust from certain of the steam-operated auxiliaries is piped. This arrangement provides a much neater appearance than obtains when independent exhaust pipes are led up alongside of the stack. On the left hand side there is a boss tapped for 3½-in. pipe for the exhaust from the two 8½-in. cross-compound air-compressors, and on the right hand side there is a boss which is tapped for a 2-in. pipe on the locomotives equipped with Worthington feedwater heaters or for a 3-in. pipe on the locomotives equipped with Wilson water conditioners. Two ½-in. drain pipes are also provided to carry off any condensation that would otherwise accumulate in the annular exhaust space.



Smokestack of Northern Pacific 4-8-4 type locomotive

EDITORIALS

Some Notes On Boiler Welding

One of the most comprehensive recent discussions of railway shop welding practice was that presented before the January 9 meeting of the Pacific Railway Club by Frank A. Longo, welding supervisor, Southern Pacific general shops, Los Angeles, Cal. Boiler welding constitutes an important part of all railway shop welding operations, and, touching this subject, Mr. Longo called attention to the excellent results being secured by the electric arc process, using heavy coated welding rod and securing welds with better physical characteristics than the original plate, as regards tensile strength, ductility and ability to withstand repeated stresses. As a result of this improved practice, firebox construction and maintenance cost have been greatly reduced.

Firebox life has also been substantially increased, an accomplishment which must be credited both to the more extensive use of treated boiler water and improved welding practices. It is reported that, on the Southern Pacific, for example, in the twelve-year period from 1913 to 1924, a total of 2,127 fireboxes were applied on the Pacific System, this number being reduced to 977 fireboxes in the eleven-year period from 1925 to 1935. At Los Angeles shops alone during the year 1920, a total of 104 fireboxes were applied. By 1925, the firebox applications had dropped to 36; and in 1935, only one firebox was applied.

An interesting suggestion is advanced regarding the welding methods used in fabricating new fireboxes. In Southern Pacific practice, the single V-type butt weld is used; and as the welders have access to both sides of the sheets, the seams are welded from both sides. After the box has been completely welded from the fire side, a diamond point chisel is used to cut a V-shaped groove in the back of the weld of sufficient depth to remove all flaws. This groove is then welded and a weld of maximum strength is secured. The caulked edges of the door sheet, flue sheet and four mud-ring corners are sealed with electric welding.

The Southern Pacific practice in applying firebox patches by welding, as described by Mr. Longo, consists of cleaning and beveling the edges of both the old and the new sheets to a 30-deg. angle, or a 60-deg. opening for both. The new sheet is bolted in place and spaced to leave a gap of 1/16 in., the seam then being tack-welded about every 15 in. to hold the patch in line, after which the straps are removed. The first, or pressure, bead is made with ⅛-in. welding wire to assure penetration, as the weld in the water side must be clean and flush with the sheets and with no gaps or mud catchers. The first bead is laid directly in the center of the seam, no attempt being made to fill the gap. After the first bead is applied, 5/32-in. and 3/16-in. electrodes are used, each layer of weld metal being thoroughly cleaned of all scale. Patches are applied to any part of the firebox.

In applying patches to the front flue sheet, enough flues are removed to enable the welder to reinforce the weld from the water side. If the back flue sheet is renewed, a ¾-in. front flue sheet is applied instead of patches, the front flue sheet being cut horizontally above the top row of flues to avoid the necessity of removing the unit header. This patched section is well braced and not subject to deterioration and cracking. Half-inch gusset plates are welded to the knuckle of the front flue sheet in the smokebox side. The life of cracked front flue sheets has been extended by welding the crack and applying these gussets, one flue sheet thus repaired having been in service for ten years and two others for eight years, each.

One of the first applications of welding on the Southern Pacific was in the welding of superheater flues to the back flue sheet. Mr. Longo's description of how this work is now done is very concise and to the point: "The holes in the back flue sheet are countersunk at a 45-deg. angle half-way through the sheet. Each flue is cut so that it will lack about 1/16 in. of coming through the sheet in the firebox. The flue is then given a light rolling to set it to the sheet, then being prossered as close to the sheet as possible. The flue is belled out or laid over in the countersink, after which the flue is welded with a good substantial bead, fusing well into the end of the flue to make a strong welded joint. There is no projection of the weld on the firebox side, as this weld is flush with the sheet and will run the life of the flues without trouble. Small flues are not welded until the life is about gone from beads. Then they are expanded, beaded, cleaned and sandblasted for welding. A small bead is welded around the original bead and the flue life extended about 14 months. In combustion chamber fireboxes it is much longer."

The detailed practices of the Southern Pacific in boiler welding are interesting and may suggest comments from readers of *Railway Mechanical Engineer,* particularly with regard to the necessity and desirability of cutting the V-shape groove in firebox butt welds, this groove then being welded with a view to securing a final composite weld of maximum uniformity and strength. A railroad locomotive shop was formerly rated more or less on the number of fireboxes it could apply, but now the emphasis is on how many fireboxes can be saved. The Southern Pacific record in this particular is impressive, but doubtless can be equalled or exceeded on some other roads. *Railway Mechanical*

Engineer would be glad to receive and publish for the benefit of its readers information regarding the maximum firebox life which is being secured by modern welding practices in boiler construction and maintenance.

New Equipment Orders in 1936

One of the most encouraging evidences of the continued progress, indeed acceleration, of recovery, is the volume of equipment orders which have been placed by the railways in the United States during the first quarter of 1936. The orders for steam locomotives during this period have completely eclipsed the orders placed throughout 1935, and those for internal combustion type locomotives, including those for new streamline trains, amount to considerably more than a quarter of the number placed last year.

During the first quarter of 1936 orders have been placed for 62 steam locomotives and 14 internal combustion locomotives, including those which will form the motive power for streamline trains now under construction. During the entire year 1935 a total of 83 locomotives of all types were ordered, of which 48 were internal combustion, 7 electrics and but 28 steam. Orders were placed for 8,913 freight cars as compared with the orders for 18,699 placed for use in the United States during the entire year 1935. In the case of passenger cars, the 37 passenger coaches and the 32 body units in the four articulated, or semi-articulated, streamline trains ordered so far this year compare with 63 passenger cars and 40 body units in the articulated trains or single rail-motor cars ordered during 1935.

Two forces are principally involved in determining the time and amount of railway equipment purchases. The first is the ability of the railways to finance the purchases, and the second is the immediacy of the need for the equipment, or, stated negatively, the degree of success with which the railways can continue to handle all business available with the existing supply of motive power and rolling stock. The second force directly affects the first, but under certain conditions may be something of a determining factor in spite of the first.

The net railway operating income of the Class I railways showed a definite improvement during the latter part of 1935 as compared with the same period of 1934, and this improvement is continuing during the present year. From September to January, inclusive, the increase has aggregated approximately one third and preliminary figures for February indicate an even better comparison with February of 1935.

During this same period increasing demands have been made on the available supply of motive power and rolling stock. The number of locomotives stored serviceable never declined below 4,000 during the peak years of 1928 and 1929. Since September 1 the number has not been above 4,000 and it had declined to 2,419 on February 1. Throughout the depression the number of locomotives on line has steadily declined and stood at 45,391 as of February 1, while the number unserviceable still holds close to 11,000 in spite of the upturn in maintenance which followed closely the increase in locomotive-miles in the last quarter last year.

Much the same trend has prevailed with respect to freight cars. The total number on line has declined steadily since 1931, while the number in shops has remained well toward 300,000 during the past three years and has not yet showed signs of an appreciable decline. Surpluses, however, have been declining since 1933 and, on the basis of the present surplus of less than 300,000, may be expected to drop close to the 100,000 margin of safety during the period of peak traffic this fall.

There is, therefore, ample reason for the increase in equipment buying which has been so marked during the past three months. Improved net railway operating income, which is the index of railway purchases, and the rapidly narrowing margin of surplus motive power and freight rolling stock are ample explanation for the increase and suggest that it is likely to continue. Whatever passenger rate reduction goes into effect in the east, it is almost sure to create an early shortage of passenger rolling stock which will have to be met by purchases of new equipment.

Railroads Make Excellent Record in Smoke Prevention

"Railroad smoke has been reduced 95 per cent, the records show. The average locomotive smoke density for 1935 was 1.727 per cent, compared to 16.03 per cent in 1931. These figures are obtained from the average of more than 10,000 Ringelmann chart readings made each year." This statement appears in the annual report of the smoke abatement engineer of Hudson County, N. J.

In February of this year 880 observations of locomotive performance were made on the nine railroads operating in that county, showing an average smoke density of 1.65. The New York, Ontario & Western led the list with a percentage of 0.00, while the Delaware, Lackawanna & Western came up in the rear with a density of 3.20, the Baltimore & Ohio being a close runner-up for the end place with a percentage of 3.00. The New York Central and the Erie fought for the second place at the top of the list, with percentages of 0.40 and 0.42, respectively. Between the extremes, graded in the order of good performance, came the Pennsylvania, Lehigh Valley, Central Railroad of New Jersey, and Reading.

These results were not obtained by the making of rules and regulations, but rather on the basis of

recommending good practices. These recommended practices, however, were not handed down as a fiat on the part of a governmental authority, but are the result of co-operative endeavor on the part of the railroads, through the organization of a Railroad Smoke Association. This organization holds monthly meetings to consider various phases of the smoke problem as it relates to the railroads. Smoke is an evidence of poor combustion and waste of fuel. The railroads profit from smoke prevention through reduced costs of operation and the community gains in cleanliness and more healthful conditions.

The railroads are not the only ones that have made a good record in Hudson County. The industrial plants are reported to have made a decrease of 93 per cent in violations in the past five years, while the steamships, tugs and ferries show an improvement of 94 per cent in reduction of violations of the smoke ordinance.

While a number of cities have smoke abatement departments, the movement seems to be gaining in impetus. That it has tremendous possibilities is indicated by a statement in the official bulletin of the Smoke Prevention Association, Inc., which is credited to Frank A. Chambers, deputy inspector in charge of the smoke abatement department of Chicago. It shows that an average of 67 tons of dust per square mile fell on Chicago last year, as compared with 95 tons in 1934, and 390 tons in 1930. The decrease in 1935 as compared to 1934, was 29 per cent.

Rough Riding Cars—What Does the Passenger Think?

During the past three or four years in which the railroads have made rapid strides in the development of equipment designed to contribute to the greater comfort of the traveling public many roads have spent considerable sums on new types of cars. New car structures have been developed with the idea of reducing the weight of cars thereby cutting down the cost of handling trains without resorting to increases in the hauling capacity of motive power. Interiors have undergone radical changes. Pleasing color schemes, more comfortable seats, air-conditioning, better lighting and improved interior arrangement have resulted in modern coaches which are far more attractive, in many instances, than the chair and club cars of a few years ago. Reduced fares have brought new customers to the railroads and, with improved schedules at higher speeds, there is every indication that the roads may look forward to a continued improvement in passenger business.

It might be well, just at this time, to call the attention of passenger equipment designers to the fact that the train-riding public is not universally enthusiastic about all of the new types of cars. When a traveler selects the railroad for a journey in preference to a bus or his own automobile he does it in many cases because he believes that he can enjoy greater comfort and safety. Judging from casual remarks that have been heard from time to time many passengers have a real cause for complaint about the poor riding qualities of some of the new equipment. It is difficult to read a book or a paper in a car that vibrates or has a tendency to side-sway to an extent that the type on a page is continually jumping before one's eyes and, at high speed, violent action of a car body gives the nervous passenger a feeling that something might happen. The fact that anything rarely does happen is of small comfort to that type of person.

Some of the new equipment that has been placed in service in the past four years is performing in a manner that is winning new friends for the railroads on every trip but, unfortunately, there are other instances where there is still much to be done to provide the traveler with the comfort he has the right to expect. Possibly it would be a good idea for the roads to make an intensive effort to find out, by contact with passengers, what they think of the riding qualities of modern passenger cars. It would at least provide much food for thought on the part of the designers of our cars.

NEW BOOKS

Speed, Space and Time. *By Vernon Sommerfield. 299 pages, 7⅞ in. by 5¼ in. Illustrated. Bound in cloth. Published by Thomas Nelson & Sons, Ltd., London, Eng. Price, $2.50.*

Here is a brief and fascinating story of "man's attack upon space and time through the development of transport by land, sea and air." By the author's dramatic assertions that "the Romans were able to travel as fast as their eighteenth-century descendants" one is brought to a new realization of how the world of transport has moved in the past century. While the book is concerned in the main with achievements of the past 50 years, it does take time for brief speculation on transport in prehistoric times before proceeding to consider in turn the ship, the highway, the railway and air transport. In his discussion of railways the author claims, among other novel revelations, that interchangeable containers for freight transport were suggested as early as 1830, and that experiments in air-conditioning of passenger cars, "so often regarded as of foreign origin," were made "so long ago as 1906 on the lines forming the East Coast Route to Scotland." Also, he finds it significant that "in the two countries in which the railway system has reached its highest stage of development—Great Britain and the United States—state ownership does not exist." A final section looks into the future, speculating on such things as the cost of speed, the prospects for railway electrification, the problem of the highways, rocket planes, and remote control of vehicles.

THE READER'S PAGE

Car Foreman Takes a Shot at "Jim Evans"

TO THE EDITOR:

I have read the stories by Walt Wyre of the terrible tribulations of an imaginary roundhouse foreman, and really they make me laugh. Of course we all know that these are stories and are somewhat overdrawn, but I do believe that some roundhouse foremen and no doubt some car foremen imagine that their lives are just like that, when as a matter of fact such cases and such days are more or less the exception, rather than the rule.

If one were to take the stories literally he would believe that the life of the roundhouse foreman was such a terrible grind that it is hardly worth living, when as a matter of fact they just can't take it. In any well organized roundhouse the life of the foreman is no different from the lives of many other railroad men, the difference being the rest of us don't wolf about it, but realize that it is all a part of the job which we hold and in which we take a great deal of pride instead of holding ourselves up as martyrs of industry. We are proud to be a part of a smooth working organization, realizing that we have good jobs paying above the average for similar positions in other industries and we learn to take the bitter with the sweet, and like it!

Every man in a supervisory position on a railroad can pick one particular day and write a story a mile long about it, which, if taken as an average or everyday performance, would make it appear that he was just in the middle of a terrible fix and bring down heaps of sympathy on his poor head. I expect if his real name were made public he would soon find himself getting more fan mail than Major Bowes. However, taking the job as a year round proposition, he has a pretty darn good job even if he doesn't know it himself.

We in the car department don't come down every morning to lie in a bed of roses, but we do come down prepared to do the job at hand with a full realization that any minute ticked off by our watch may bring an emergency to take us off our regular spread and routine. Maybe it is a wreck, or one or a dozen hot cars switched to the rip for a manifest train which is called for an hour or two later, and every one of those cars must be fixed and switched back into the train without any delay. What do we do about it—tear our hair and blow up and write a story about it? No, we simply break up our present spread, take enough men out to fix the loads and everything goes along in a smooth and orderly manner; we fix the loads, get them out, and think no more of it.

We also have our material shortage problems and take orderly and proper steps to correct such conditions. When we do get up against it we don't hunt someone's shoulder on which to weep, but take steps to cover the situation either by making the material needed or by robbing another car, or what have you.

There is in my estimation no job of any kind on any railroad where a smooth running, orderly organization cannot be perfected and click as it should without any supervisor being in the same position as a man in jail, or a martyr to his great cause; nor should any well managed job be so confining that the foreman can't find any time whatever for relaxation of some kind without having to lay off to do so.

In short, it's just the old, old story. The roundhouse foreman or master mechanic all think because they are the birds who work on the engine that they are the whole railroad and that just because they put the engine on the head end of the train it is the money-maker, or the whole train, when as a matter of fact the engine is just a necessary nuisance and a money-spender rather than a money-maker. The cars that follow it are the boys that bring in the long green, and the "Dusty Buts" are the birds that keep them going.

Anyway I'll be happy for Jim Evans' sake when summer comes, because then he can have all daylight with which to play with his little engines and he won't have any frozen branch pipes; he may also have time to see his kids in daylight and find what a pretty world he really is living in.

A CAR FOREMAN

Larger Fireless Locomotives

TO THE EDITOR:

We were interested in the Rail Oddity by Marinac in the *Railway Mechanical Engineer* of February, 1936, page 84, depicting the fireless locomotive which is used at the Brooklyn Navy Yard. In the description of this unit, however, we note a gross error. It states that the Navy Yard engine is the largest fireless switching locomotive ever built. There are 12 fireless steam locomotives operating in this country which are very considerably larger than the Navy Yard engine, including a 65-ton, six-driver, fireless locomotive which we built last year for the Ford Motor Company at Dearborn, Mich.

HARVEY LEFEVRE,
Manager of Sales,
Heisler Locomotive Works.

[A folder which came with the letter indicates that these locomotives are built in all sizes from 5 to 90 tons.—Editor.]

First All-Welded Car

TO THE EDITOR:

Will you kindly tell me when, where and by whom the first successful, all-welded railway car of any type was built in this country.

H. O. HAVEMEYER, JR.

The Baltimore & Ohio exhibited an all-welded, 95-ton capacity hopper car at the Mechanical Division convention in Atlantic City in June, 1930. Have any of our readers records of all-welded steel cars built prior to that time?—Editor.

Gleanings *from the* Editor's Mail

The mails bring many interesting and pertinent comments to the Editor's desk during the course of a month. Here are a few that have strayed in during recent weeks.

Advertise Railroad Service

The automobile manufacturer does not hesitate to spend thousands annually to advertise his product in beautiful colors, and the railroads could and should do likewise.

Speaking of Shop Accidents

I went into one big shop noted for its fine safety record, but found men using crutches, fingers bandaged up, one with an eye blinker on, and learned that if it was at all possible they were kept at work so long as they could do anything at all. I wonder if this is how some of these fine records are made. With us a man does not start to work until he is practically able to resume his old job in an efficient manner.

Air Brakes and Faster Schedules

The Air Brake Association is one organization that has been very beneficial to the railroads as a whole. This association has not held a meeting for some time and I feel that with the improvement in operation of the railroads—that is, faster schedules and lighter trains—this association will again become a prominent factor in the formulation of rules and regulations to be applied in the handling of faster schedules, both freight and passenger.

A Large Vision

Give us editorials inspiring us to the responsibilities of leadership on our jobs and in our communities, inspiring us to face courageously the problems that confront railroaders in the changing world of economics, finance and scientific discovery we are passing through, reminding us that no country ever found its place as a great nation and shaped its destiny until it had men to face and overcome the greatest of difficulties in building its railroads; and no country can continue to hold its place without efficient, well managed railroads. Help us to follow worthily in the steps of the great captains whose names adorn the pages of our railroad history.

The Kid Glove Foreman

Some of the situations encountered by the "Kid Glove Foreman" (January, 1936, page 34) are humorous when seen from one angle, but tragic when considered from the angle of good supervision. It seems to me he should have learned the lesson of "being a new man on the job" and have refrained from hasty decisions and jumping at conclusions until he had become thoroughly familiar with the layout of the new plant and also knew something about the ability of the individual workmen. The general foreman or the master mechanic should have been interested enough in the new foreman's welfare to have accompanied him about the premises more than a half hour or so the first morning, just by way of seeing that he got an even break or better.

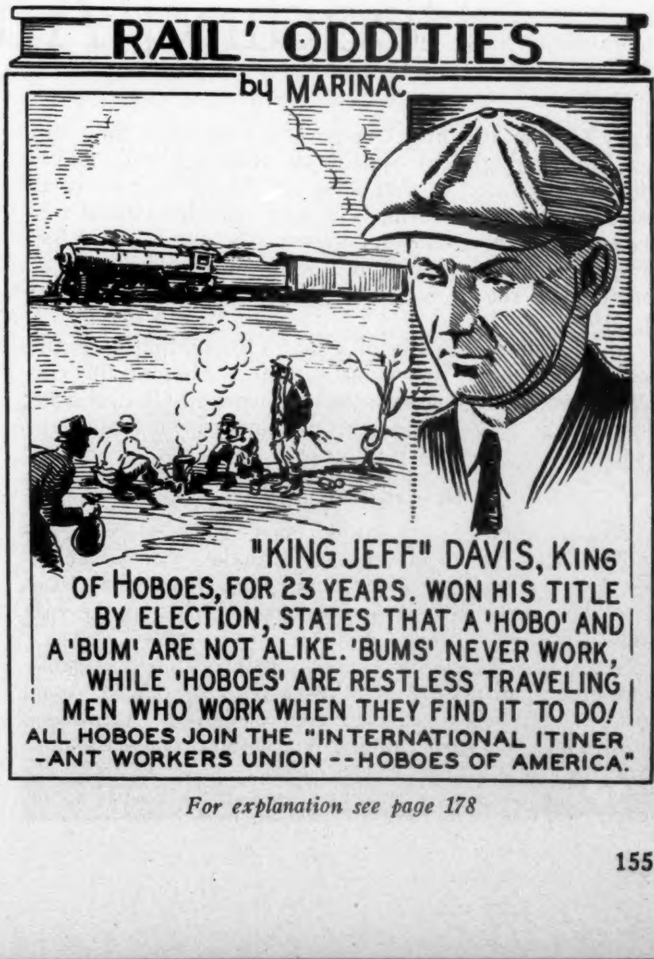
Roundhouse Facilities

I must say that in my opinion these roads were at least 30 years behind time in their roundhouses. They were not equipped with electric drop pits and I noticed that they were washing boilers and packing boxes in the yard, where they did not have any kind of pit. This was more noticeable to me, due to the fact that we have a modern roundhouse, each stall being equipped with chain falls on both sides. We also have four electric drop pits, a monorail running the entire length of the house, two 10-ton Whiting hoists, and many other modern conveniences.

Wood Burning Locomotives

Many changes have taken place since I first started. It may interest you to know that I completed my first general arrangement drawing at the Richmond Locomotive Works, where I was first employed, on November 3, 1889, and the locomotive in question was a wood burning engine for the Raleigh & Gaston Railroad. The engine had 17-in. by 24-in. cylinders and about 25,000 lb. per axle. Prior to that time they built what they called "pole" road locomotives and they were used for logging purposes. The wheels were made to fit over a round pine pole. The track was made by laying pine poles lengthwise—mostly in the mud. Probably they were tied across at some places, but the wheels were really double flanged and were kept on the road in this way. They seemed to have had quite a business along this line at one time, it having been inherited from the Tanner & Dulaney Engine Company.—*John A. Pilcher, mechanical engineer, Norfolk & Western Railway.*

* * *



For explanation see page 178

With the Car Foremen and Inspectors

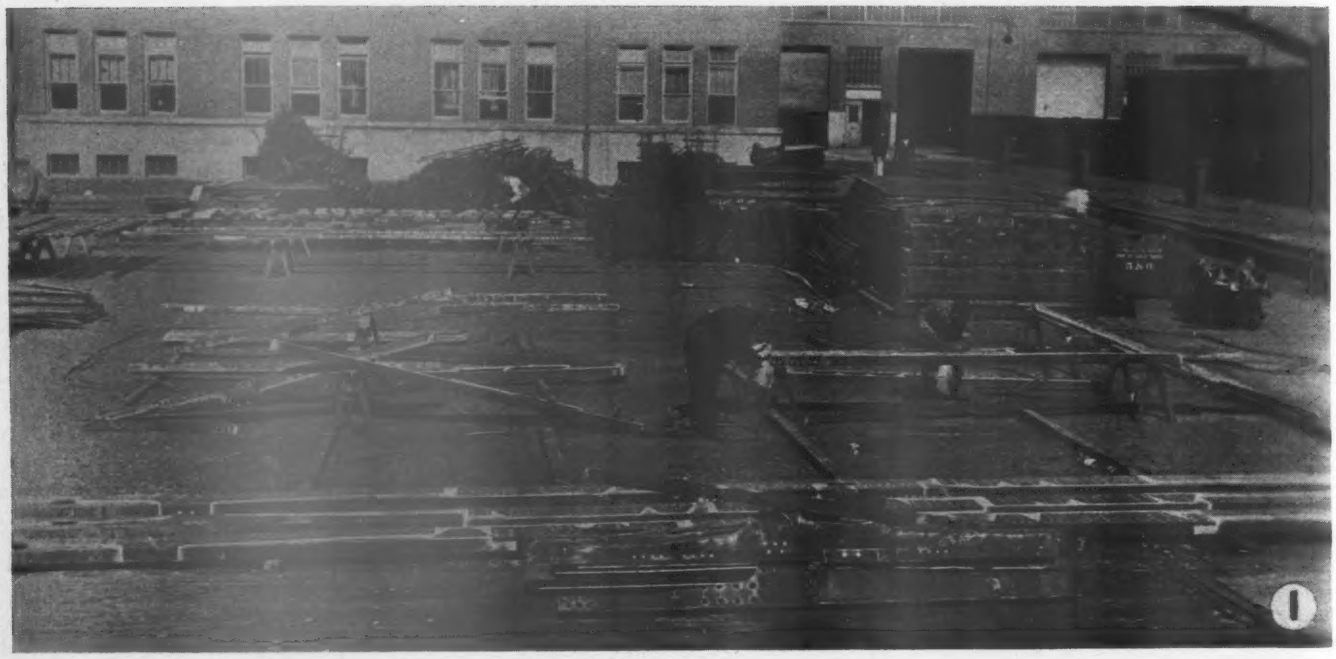


Fig. 1—Many steel parts were laid out with template and spray gun.

Four Weeks to Rebuild 100

Reading Automobile Cars

In 1927 the Reading Company completed a new shop for heavy freight-car repairs at Reading, Pa., and in 1932 inaugurated in that shop the "spot" system of repairs in its present form. The spot system included a coordinated material delivery system, the operation of both of which were described in a joint paper presented at a meeting of the New York Railroad Club on October 20, 1933.*

An excellent example of a major rebuilding operation carried on under this shop system is that of the conversion of 100 single-sheathed box cars to all-steel automobile cars with Duryea cushion underframes and auto loaders.

Description of Cars

The rebuilt cars are known as Class XARA, Series 18,700 to 18,799, of all-steel construction with wood lining, Duryea cushion underframes and Evans auto loaders. The principal dimensions and weights of the cars are as shown in Table I.

Other specialties on these cars are the AB brake equipment, furnished by Westinghouse; Ajax hand brake; Creco ball-bearing double doors; Alan-wood Super-Diamond steel running boards and roof platforms; Type E couplers, Creco brake beams and bottom rod supports, and the Cardwell-Westinghouse truck springs.

Rebuilding Operations

The first car in this series to be completed was turned out of the Reading shop on October 12, 1935, and the last of the 100 cars left the shop on November 9, 1935.

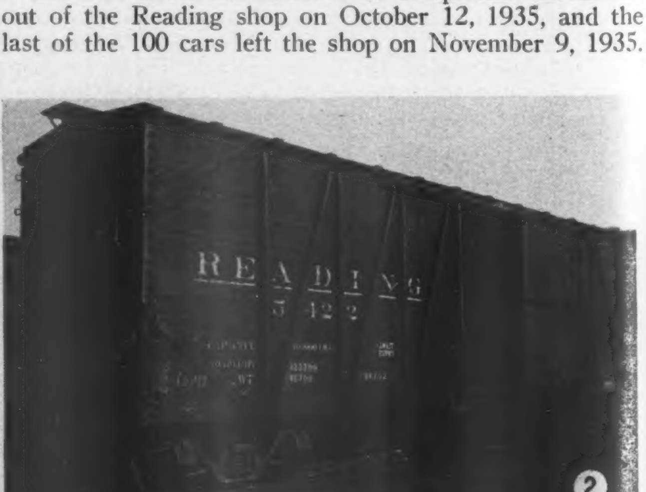
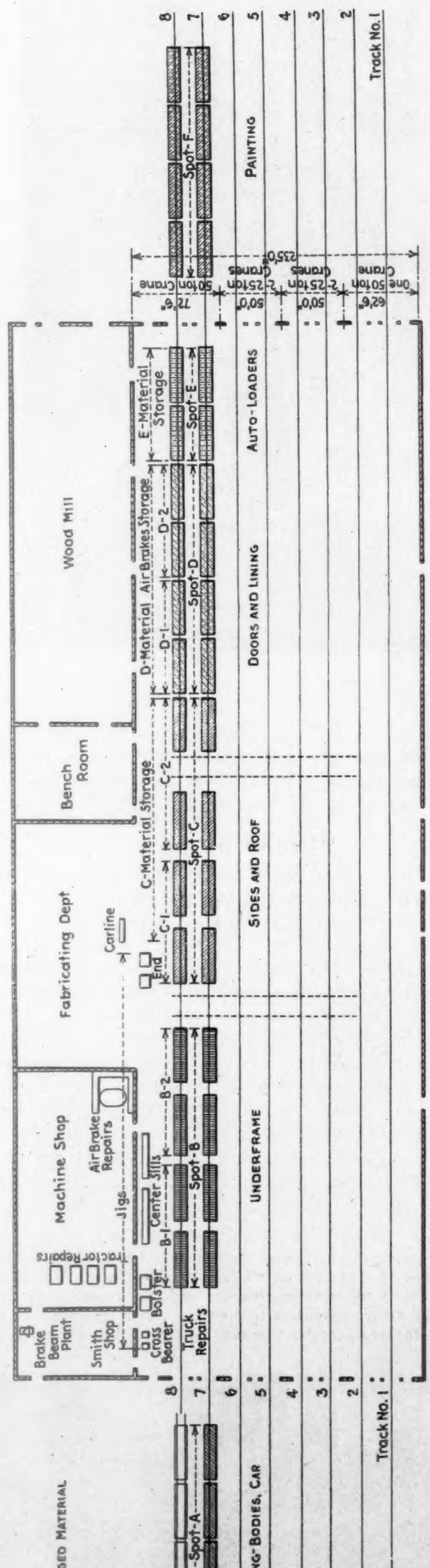


Fig. 2—One of the original single-sheathed box cars before conversion

* The operation of the spot system at the Reading car shops was described in an abstract of the New York Railroad Club paper in the December, 1933, issue of the *Railway Mechanical Engineer*, page 442.



The layout of the shop showing the locations of the several spots

An average output of four cars a day was planned before the work was started and that schedule was maintained without difficulty.

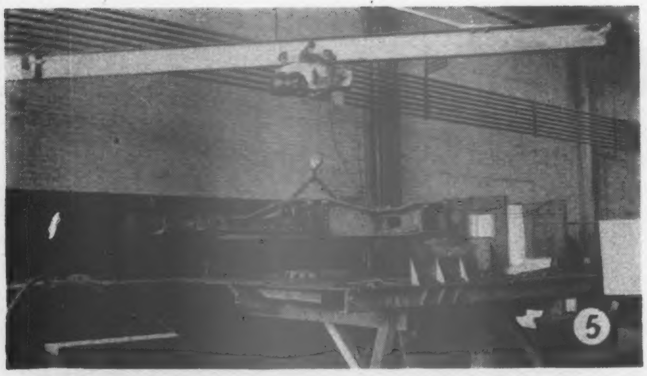
The material used in these converted cars was fabricated in part by the Reading shop and in part by the Parish Pressed Steel Company, Reading, Pa. Those parts fabricated by the railroad company were body bolsters, center sills, cross-bearers, carlines, body ends and miscellaneous gussets and braces. The complete sides, ready to apply the roof sheets, running boards and brake steps were fabricated by the Parish Company and delivered to the shop ready for assembly. With the exception of certain parts of the center-sill assembly the cross-bearers and minor parts, new material was used in these cars.

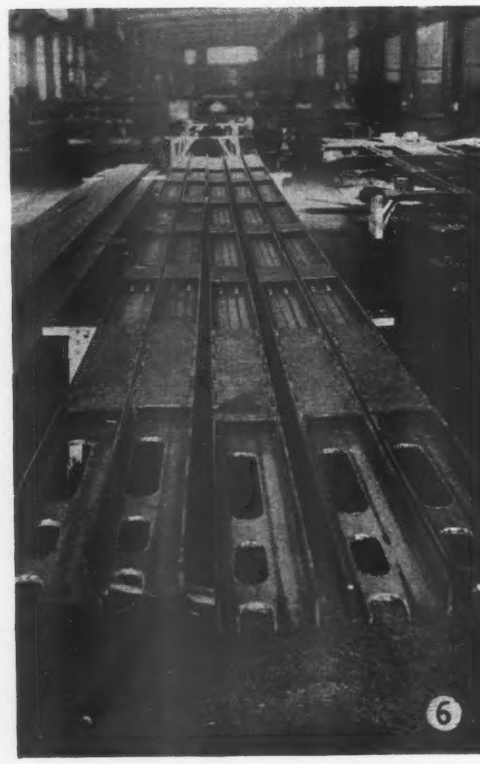
Table I—Principal Weights and Dimensions

Capacity	100,000 lb.
Light weight	56,500 lb.
Capy. in cu. ft. (with auto loader down)	3,840
Capy. in cu. ft. (with auto loader up)	3,620
Length, coupled	45 ft. 1½ in.
Length, over striking castings	42 ft. 10 in.
Length, inside	40 ft. 6 in.
Truck centers	31 ft. 1½ in.
Truck wheel centers	5 ft. 6 in.
Height, over running boards	14 ft. 8⅛ in.
Height, at eaves	14 ft. 1⅛ in
Height, inside (with loader up)	9 ft. 9 in.
Height, inside (with loader down)	10 ft. 4⅛ in.
Height, door opening	9 ft. 8⅛ in.
Width, overall	10 ft. 6 in.
Width, over side sills	9 ft. 9⅜ in.
Width, inside	9 ft. 2 in.
Truck type	Andrews
Journal size	5½ in. x 10 in.
Wheels, cast iron, diameter	33 in.

The various operations were performed at six shop

Fig. 3: The stripping process practically complete—Fig. 4: Cross-bearer assembly in the jig





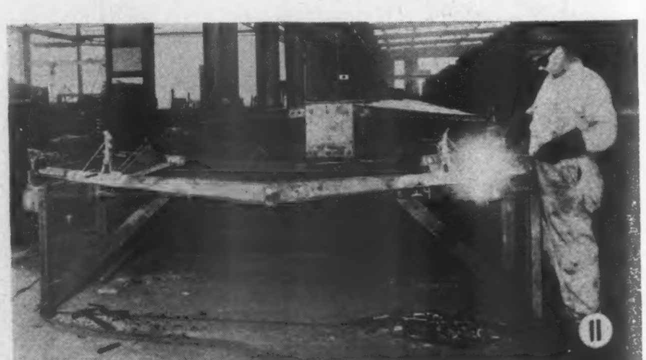
locations or "spots" and each individual car consumed 11 days in passing through the shop, from stripping to final inspection. All operations were timed to produce the average output of four cars a day.

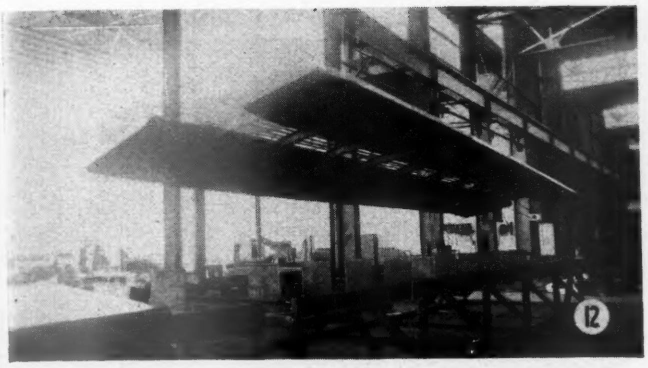
Detail Operations

First Day.—Four cars were taken into the shop at Spot *A* and completely stripped. The material was sorted and sent to scrap or, if to be used over, to the fabricating shop.

Second day.—The assembly operations started at Spot *B-1*. On this day cross-bearers, bolsters and center sills were fitted, welded, reamed and riveted up. Production was simplified by the general use of assembly jigs. Wherever possible the oxy-acetylene torch was used to cut out shapes and Fig. 1 shows how the center-sill channels were laid out with templates by the use of a spray gun and white paint. No center punching was done—even the holes to be punched for rivets were located by a template and the spray gun. The jig for the

Fig. 5: Removing the assembled body bolster from the jig—Figs. 6 and 7: Two views of the work on the center sill—Fig. 8: The underframe assembly—Fig. 9: Assembling the car ends on a special jig—Fig. 10: Applying the carline extension to a carline in the jig—Fig. 11: Welding the brackets for the auto loader to the carlines





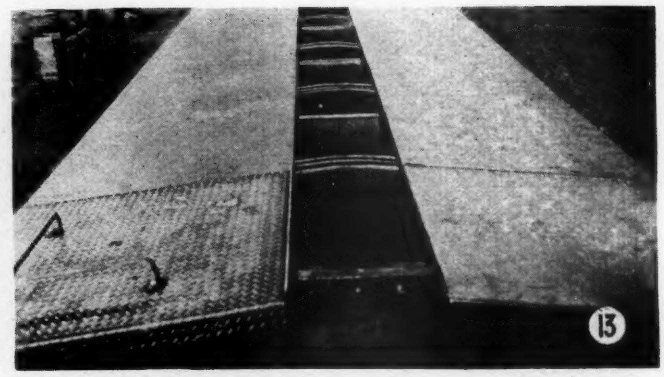


Fig. 12: The roof assembly jig—Fig. 13: The roof sheets in place before welding on the running board—Fig. 14: The fabricated car sides as received at the shop—Fig. 15: Applying the car sides to the underframe—Fig. 16: One of the cars at the completion of the superstructure assembling operation—Fig. 17: Fastening down the metal door sill with an electric screw driver—Fig. 18: The template used for locating the holes to be bored in the floor for the auto loader

assembly of the cross-bearers is shown in Fig. 4; the bolster assembly is shown in Fig. 5 and two views of the work on the center sills are shown in Figs. 6 and 7. The cross-bearers were fabricated from body side posts and stakes from the old cars, the bolsters were also made from materials from the old cars, except the top and bottom cover plates, which were new. The center sills had new channels and buffer castings with second-hand stiffeners, draft stops, top and bottom cover plates, tie plates and draft-gear carrier plates.

The trucks were overhauled by a separate truck gang at Spot *B* on the second day.

Third day.—At Spot *B-2*, the assembly operations on the underframe were performed. This is shown in Fig. 8.

Fourth day.—At Spot *C-1* the car ends were assembled on jigs as shown in Fig. 9. These ends were from the old cars with extensions riveted between the

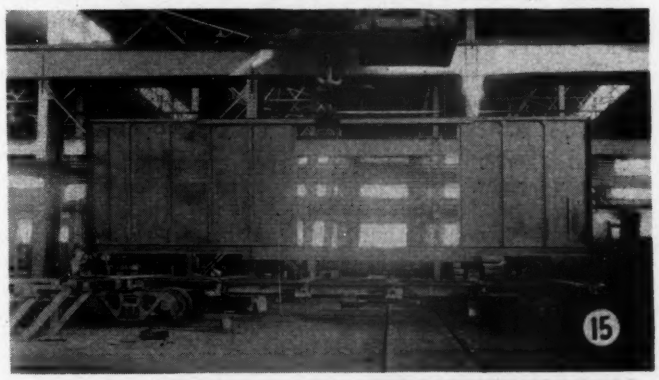


Fig. 19—Boring the holes for the auto loader

Fig. 20—The power saw for cutting the rectangular holes

top and intermediate sections to increase the height. The assembly of the new car ends on the jigs included the card boards, hand-brake mechanism, brake step and running-board braces and chain hoists for the auto loader.

The job on the roof consisted of the preparation of the carlines by cutting off the ends of the old carlines, riveting on new ends with the aid of the jig shown in Fig. 10 and welding the brackets for the auto loader to certain carlines as shown in Fig. 11. The carlines were then set up in the roof jig shown in Fig. 12 and the roof sheets were riveted to the carlines.

There are three interesting features of the roof construction. The roof sheets on each side are flanged up near the center of the car to receive the Super-Diamond steel running board which, in effect, forms a cap that is welded full length to the roof sheets, making a water tight joint. By this construction an amount of material approximately equal to the running-board area is saved. The other features are the elimination of the corner roof platform by the use of the Super-Diamond steel sheet, and the roof sheets, which run longitudinally instead of across the car. (Figs. 13 and 22.)

The car sides, as previously mentioned, were fabricated outside and delivered for assembly at this point in the schedule. Figs. 14 and 15 show the car sides before and during assembly to the underframe.

At Spot *C-1* the sides and ends were bolted to the underframe, the roof assembly bolted on and the entire body reamed for riveting. This was done at Spot *C-2* on the *fifth day*. Fig. 16 shows the car at the completion of these operations. At this spot the brake equipment and piping were also applied.

Sixth day.—At Spot *D-1*, couplers, safety appliances, door brackets, door tracks and fixtures were applied and the car floors were put in. Fig. 17 shows a workman fastening down the metal door sill by means of an electric screw driver.

Seventh day.—Linings, nailing strips and door posts were applied at Spot *D-2*.

Eighth day.—At this point in the schedule the auto loaders were applied at Spot *E-1*. The installation of each one of these loader units required the cutting of several large round and rectangular holes in the car floor. Formerly it was the practice to establish the location of

Fig. 21—Interior of the car with the auto loader in place

Fig. 22—A top view of the finished car

each hole, bore around a circle or rectangle with a brace and bit and chip out with a hammer and chisel. The method by which it was done on these cars is shown in Figs. 18 and 19. These show, respectively the template for locating the holes and the jig and tool in use, boring the holes. Fig. 20 shows a power saw for cutting the rectangular holes. The loader, installed, is shown in Fig. 21.

On the eighth day, the card boards were applied, the cars given final inspection and air brake tests. They were then ready to leave the shop for painting.

Painting

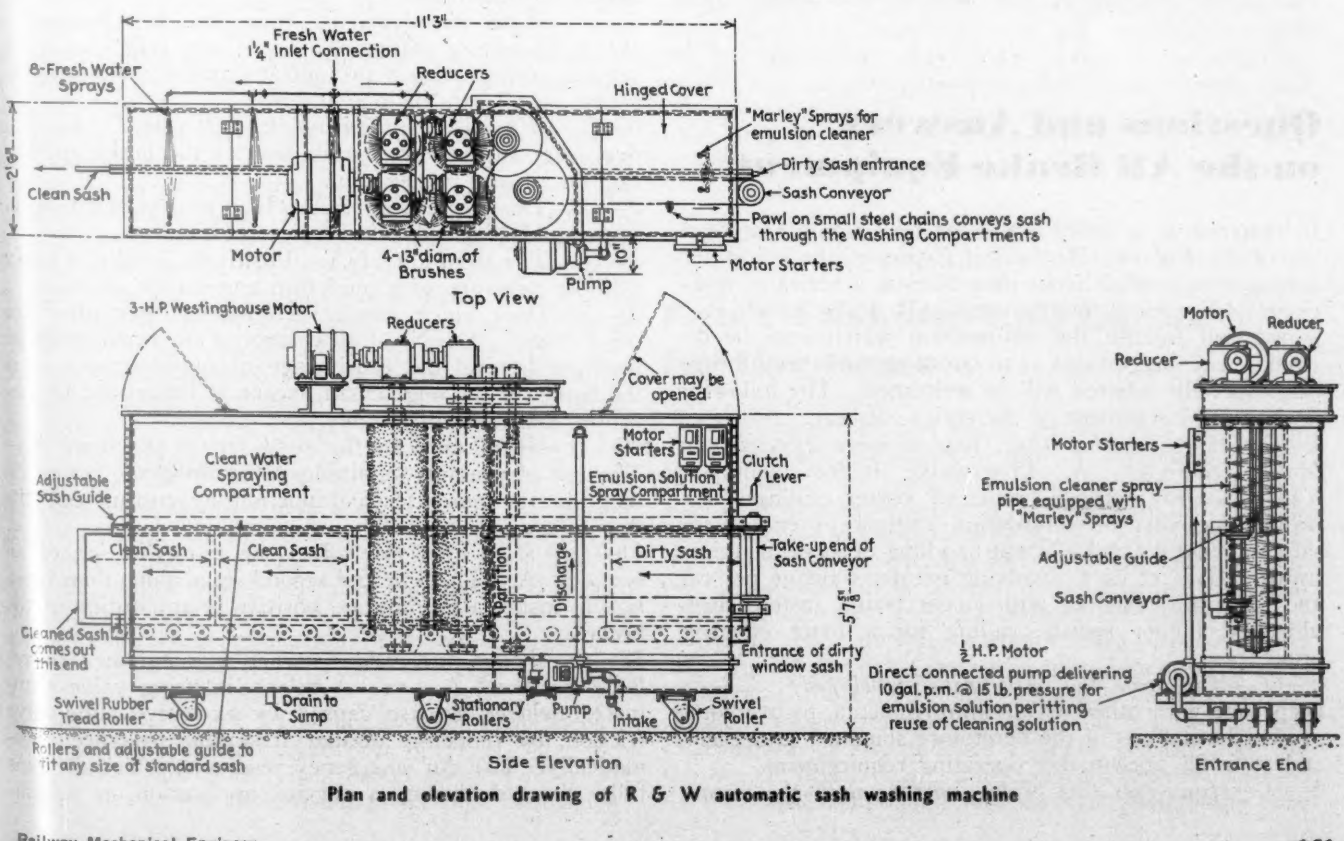
All sheets used in the construction of these cars were given a coat of red lead before assembly and, at Spot *F*, on the ninth day the cars were given a ground or primary coat, by the spray process. On the tenth day they received a finish coat and on the eleventh day they were stencilled. A top view of the finished car is shown in Fig. 22. The entire underframe, the inside of the car ends and 24 in. at the bottom of the sides as well as all laps, joints and the inside and outside of the roof were sprayed with a coat of car cement during assembly. After the paint was dry the cars were given a leakage test, and were then ready for service.

Passenger Car Sash Washing Machine

In addition to its automatic car washer, the Ross & White Company, Chicago, has recently perfected and placed on the market a portable automatic machine for washing passenger car sash at a substantial saving in time and cost over previous hand washing methods. The cleaning of individual sash for passenger cars undergoing repairs at car shops is a routine operation involving considerable expense throughout the year, and, in addition, some railways have to clean as many as 50,000 storm sash within a comparatively short period each fall in preparing passenger equipment for winter service. The sash-washing machine designed to clean sash automatically and thoroughly by electric power in about one minute per sash and at a cost of two cents per sash, which may be compared with five cents per sash for hand washing.

The Ross & White sash washer is designed to be operated by one man who feeds in the dirty windows at the entrance end of the machine and receives the clean, washed windows from the delivery end. The machine consists of a structural steel plate box 11 ft. long, 30 in. wide and 5 ft. 7 in. high, mounted on four 6-in. roller-bearing wheels, two of which are fixed and two, at the ends, arranged to swivel. The box is divided into two compartments, the first of which contains an acid spray for cutting the dirt. The second, or larger compartment, contains the motor-driven cleaning brushes near the center of the machine, and a clean water spraying compartment in the other end.

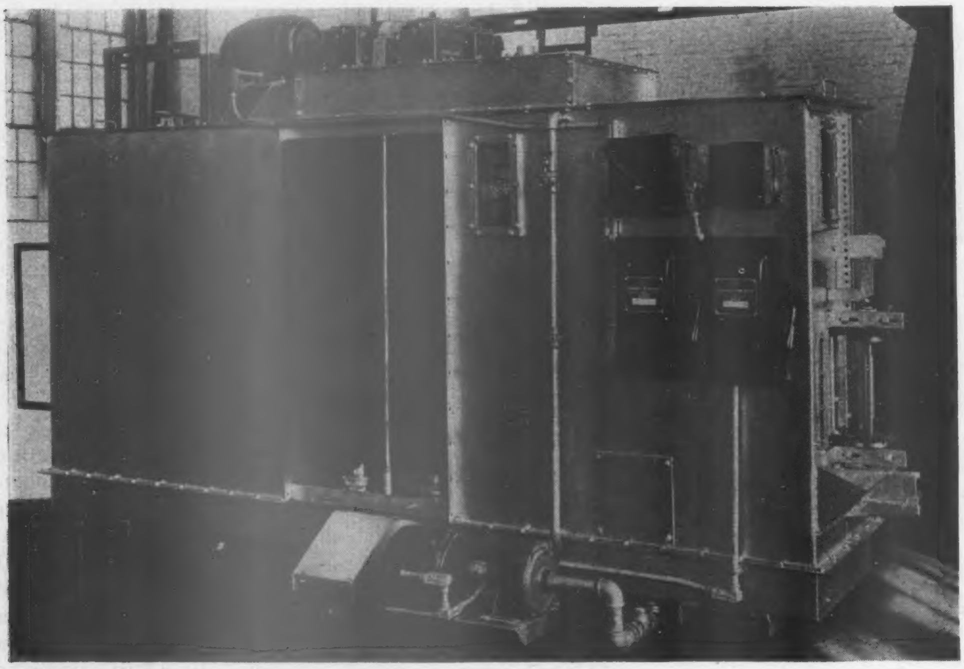
The dirty sash, which can be handled in all sizes up to 42½ in. high, are placed between roller and channel iron guides at the center of the receiving end where they are conveyed forward by a pawl on a moving bicycle chain. The sash are first covered with a spray of Imperial emulsion solution, or other acid if desired, this solution being reclaimed and recirculated by a small, electric, centrifugal pump located on one side of the box near the bottom, as shown in the illustration. The sash are slowly conveyed between four 13-in. diameter, fast-revolving brushes, moving in opposite directions so as to cover all crevices of the sash and thoroughly scrubbing off the dirt. After being pushed through the motor-driven brushes, six sprays of clean water cover the sash thoroughly, cleansing them as they are gradually pushed out of the delivery end of the washing machine. The dirty spray water leaves the bottom of



Plan and elevation drawing of R & W automatic sash washing machine

the water spray compartment through a hose connection to the drain.

An automatic throw-out clutch is provided to start and stop the machine which is readily portable and can be moved from one location to another, receiving its power from an electric line plugged into the starting box. The revolving brushes are driven by a 3-hp. Westinghouse motor through Cleveland worm-gear silent speed reducers. In case the condition of the sash does not require use of the acid spray, this spray can be shut off and the sash run through the machine and thoroughly cleaned by the brushes and water spray alone.



The R & W automatic car sash washer is a compact portable unit

Questions and Answers on the AB Brake Equipment

In response to a desire expressed by a number of readers of the *Railway Mechanical Engineer,* the editor has arranged to publish from time to time a series of questions and answers on the new AB brake which it is hoped will furnish the information which may be desired. Any suggestions as to questions or as to information especially desired will be welcomed. The following is the first installment of the series—Editor.

1—*Q.—Why, at this time, was a more effective air brake required?* A.—Progressive improvements in transportation methods, required correspondingly improved methods of retardation control to enable the safe, expeditious and efficient handling of modern freight trains. Heavier cars, involving greater tonnage per car and per train, together with longer trains, faster schedules and higher speeds, calling for a more effective brake.

2—*Q.—Why was the AB brake developed?* A.—To keep pace with other major improvements, to overcome present limitations of the heretofore standard equipment, and to fulfill present day operating requirements.

3—*Q.—How does this brake compare with the former standard type?* A.—The proved, good operating features of the former brake are retained and other features added, notable among which are forms of construction designed for economical maintenance, and protective devices for the exclusion of dirt. The entire equipment is arranged for installation on the car with a maximum insurance against leakage, and for convenience in cleaning, inspecting, etc.

4—*Q.—In what features have improvements been made in the AB valve as compared with the old type?* A.—Quick-service, release, and emergency positions contain added improvements.

5—*Q.—What improvements have been incorporated in the quick-service features?* A.—Three stages of quick service now provide a prompt and positive brake application on all cars of long trains.

6—*Q.—What happens during the first stage?* A.—The first stage insures prompt starting of the brake application on all cars in the train.

7—*Q.—The second stage?* A.—Insures movement of the piston and slide valve to service position.

8—*Q.—The third stage?* A.—Positively developes brake cylinder pressure of a moderate amount on all cars.

9—*Q.—Does quick service activity continue after the third stage?* A.—No. Full control of the brake cylinder pressure beyond the third stage of quick service is in the hands of the engineman except as influenced by improper and undesired brake pipe leakage.

10—*Q.—What modifies the quick-service function?* A.—The use of pressure retaining valves in grade operation modifies the quick-service function by cutting out the third stage automatically.

11—*Q.—How does this affect the re-application of all brakes?* A.—The first and second stage alone then function to insure a prompt and positive re-application of the brakes.

12—*Q.—What improved features are contained in release position?* A.—(a) A release-insuring valve eliminates delayed release caused by excessive slide-valve friction, by reducing auxiliary-reservoir pressure automatically. (b) An emergency reservoir, which remains fully charged during a service application, is instru-

mental in obtaining a rapid increase of brake-pipe pressure when release is started, due to the fact that the auxiliary reservoir is initially recharged from the emergency reservoir instead of drawing air from the brake-pipe supply. (c) After emergency, the rate of brake pipe build-up is hastened by discharging (during a fixed period of the release operation) brake cylinder and auxiliary reservoir pressure into the brake pipe. The partial restoration of brake pipe pressure from this source assists in the accomplishment of a prompt and positive release.

13—*Q.—What important features are embodied in the emergency position?* A.—(a) Elimination of undesired emergency during a service application, accomplished by a separation of the controlling parts for service and emergency operations. (b) Protection against undesired emergency during release, insured by preventing overcharge of the quick action chamber. (c) Emergency quick action obtainable at any time regardless of the state of service application or release. (d) 20 per cent higher brake cylinder pressure than that obtained from a full service application, the speed of which is 40 per cent faster than with the former standard freight brake equipment. (e) Damaging shocks prevented by the development of emergency brake cylinder pressure in steps.

14—*Q.—Name and describe the general features of the AB brake equipment?* A.—(a) A removable hair strainer (with by-pass protection against stoppage) which serves to lengthen intervals between cleanings by preventing passage of dust particles (too fine to be caught by the dirt collector) to the operative parts of the valve and to the brake cylinder. (b) A duplex release valve, operative from any angle, for bleeding auxiliary and emergency reservoirs. The construction of the valve permits discharge of air from both reservoirs at the same time or the auxiliary reservoir pressure alone. (c) A pipe bracket, mounted on the car permanently, carrying the valve portions and pipe connections so that removal of valve portions does not necessitate breaking pipe joints. (d) Reinforced flanged union pipe connections which support the pipe, providing against brake pipe breakage and loosening of joints. (e) A brake pipe tee with flanged union connections and a lug providing a means of anchoring to the car body. (f) Combined auxiliary and emergency reservoirs into a two-compartment reservoir of sufficient strength to withstand maximum operating pressures. (g) Brake cylinder is fitted with an improved packing not requiring a follower plate, simplifying replacement. Brake cylinder is also provided with a means for continuous lubrication of cylinder walls without opening the cylinder; lubrication of piston rod and protection against entrance of dirt.

15—*Q.—What provision is made for cars exceeding in weight the capacity of the 10-in. brake cylinder?* A.—Parts can be added for use on these cars without change in the operating portions or in the two-compartment reservoir.

Parts of the Equipment

16—*Q.—Name the parts which make up the AB freight car equipment?* A.—(a) AB valve (b) Brake cylinder (c) Two-compartment reservoir (d) Combined dirt collector and cutout cock (e) Branch pipe tee (f) Pressure retaining valve (g) Angle cock on each end of brake pipe and (h) Hose connections and couplings.

17—*Q.—How many portions does the AB valve consist of?* A.—Three.

18—*Q.—Name them?* A.—Pipe bracket (two faced); service portion; emergency portion.

19—*Q.—To what is the pipe bracket connected?* A.—It is bolted to the car underframing, all pipe connections being made permanently to the bracket; service and emergency portions are bolted to it.

20—*Q.—What does the pipe bracket contain?* A.—A removable hair strainer and a quick-action chamber.

21—*Q.—What does the service portion control?* A.—Controls (either directly or through the medium of the emergency portion) the desired charging of reservoirs, also service application and release of brakes.

22—*Q.—What does the emergency portion control?* A.—the quick action feature controlled high brake cylinder pressure and the accelerated emergency release function.

23—*Q.—Is the hair strainer in the pipe bracket the only fixture for catching dirt?* A.—No. Brake pipe air passes through a dirt collector prior to entering the strainer.

24—*Q.—Name and locate the pipe connections on the bracket portion?* A.—Auxiliary reservoir, on upper left; Emergency reservoir on upper right; Brake pipe, lower left; Brake cylinder, lower right; Retaining valve, center.

25—*Q.—How is the brake pipe connected to the bracket portion?* A.—By means of the combined dirt collector and cutout cock.

26—*Q.—How is the dirt collector attached to the bracket portion?* A.—By means of a flange connection cast on the dirt collector.

Service Portion

27—*Q.—Name the operative parts of the service portion?* A.—Service piston, slide and graduating valves, release-insuring valve, limiting valve, back-flow check, release valve, release and application bypass check valves, service piston return-spring and stabilizing spring and guide.

28—*Q.—What is the duty of the service piston?* A.—To operate the slide and graduating valves. It also serves as a dividing line between the brake pipe and auxiliary reservoir.

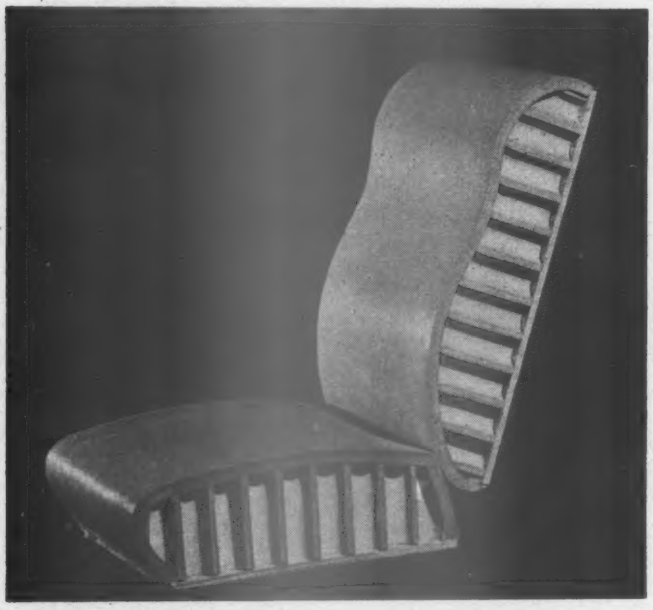
29—*Q.—What is the duty of the service slide valve?* A.—It opens and closes communication between (1) Auxiliary reservoir (service slide valve chamber) and emergency reservoir, past the graduating valve. (2) Brake pipe and quick service volume, through the graduating valve. (3) Brake pipe and brake cylinder, through the limiting valve. (4) Brake cylinder and retaining valve. (5) Auxiliary reservoir and brake cylinder past the graduating valve. (6) Auxiliary reservoir and the inner area of the release-insuring valve. (7) Inner area of release-insuring valve and retaining valve (exhaust).

Latex Cushions and Backs for Car Seats

A type of cushions and backs for the seats of railroad passenger cars and buses formed of vulcanized cellular rubber foam has been developed by the Mishawaka Rubber & Woolen Manufacturing Company, Mishawaka, Ind. Because of the thousands of tiny, intercommunicating rubber cells they have a vibration- and shock-absorbing action said to be several times that of the usual style of cushion. They are likewise completely porous so that in action they are self-ventilating—air constantly being forced through them, in use, thereby keeping them cooler than the conventional cushion.

Other advantages claimed for these cushions include a reduction in maintenance expense because they do not sag or break down; and because they are moulded to the exact shape and size desired, installation cost

is reduced. Likewise because padding and stuffing are unnecessary, trimming cost is reduced to a minimum. In cases where it is desirable to save head and leg room these cushions have an advantage over conventional



Section of Mishawaka seat cushion and back

cushions because they do not need to have similar thickness for equal resiliency and shock-absorbing action.

These cushions are now in use on a number of railroad and bus lines.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. A. R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Wheels, Loose, Removed by Owner—Joint Evidence Necessary to Establish Improper Repairs

The Illinois Central in rendering a bill against the Southern Pacific charged for new wheels applied to S. P. car 15068, May 20, 1933. Southern Pacific presented billing repair card showing wheels removed at Bakersfield, Calif., December 21, 1933, account wheel loose on axle and requested adjustment under Rule 81. Illinois Central contended that joint evidence per Rule 21, establishing defects necessitating removal must be furnished in support of claim. Southern Pacific claimed this to be unnecessary and failing to agree, the case was submitted for decision.

The Southern Pacific in its statement said that the question at issue was whether or not joint evidence as provided in Rules 12 and 13 is necessary to support claim of loose wheels under Rule 81 when owner's wheel record card showing full information in connection with the removal is matched against billing repair card and wheel record card of the road previously applying such wheels. The S. P. maintains that every purpose is served and all requirements fulfilled by their wheel record card and that it is conclusive evidence that loose wheel was found and replaced. The fact that the exchange was made by car owner does not weaken evidence or require additional support. It is contended that billing repair card and wheel record card of Illinois Central establishes their responsibility under Rule 81.

The Illinois Central in its statement said that their contention was based on last paragraph of Rule 81 which states that car owner is entitled to protection for loose wheels removed within one year of the date of application on basis of wrong repairs. The procedure to be followed in presenting claims for wrong repairs is contained in Rules 12, 13 and 90. The first two rules apply to car owners correcting repairs and it is a requirement of these rules that joint evidence certificate be furnished in support of claim. The last rule, which applies to wrong repairs corrected by an intermediate line, states that repair car on road correcting repairs shall perform the same function as a joint evidence certificate. From the wording of these rules it is clear that all claims of wrong repairs must be supported by joint evidence or equivalent, and there is no rule or arbitration decision that car owner repair cards constitute either of these. It is, therefore, contended that claim of S. P. has not been properly established.

In a decision on April 11, 1935, the Arbitration Committee said: "The Southern Pacific being the car owner in this case, and having removed the loose wheel on its line, should have obtained joint evidence and handled same under Rules 12 and 13 and time limits of Rule 81. The contention of car owner is not sustained."—*Case No. 1743, Rules 12 and 81, Southern Pacific vs. Illinois Central.*

* * *

For explanation see page 178

IN THE BACK SHOP AND ENGINEHOUSE

A Mysterious Leaky Throttle

Old timers can tell some tall tales about queer happenings in the shop and roundhouse. Here is one that actually happened not long enough ago to be ancient history for it occurred during the present short-time period. The throttle of a large passenger engine just out of the back shop was continually reported by enginemen to be badly leaking. Whenever this engine was fired up it blew heavily out of the relief valves on the valve chamber and at the cylinder cocks. The throttle valve was repeatedly ground and tested by experienced steam-pipe men, and since the leak continued the general foreman was convinced that there was a hole in the dry pipe, and he personally got inside the boiler and examined the pipe while it was under hydrostatic test—full of hot water at 90 lb. pressure. Everything seemed O.K. including the throttle, throttle box, and standpipe which were tested hydrostatically with hot water outside the engine and again after assembling in the boiler. After the engine was fired up the throttle leaked the same as before, and while the supervisors were having a conference in the office the steam-pipe man (who had been subject to considerable criticism) took out the throttle assembly again. He made a few measurements and then called the boss over and told him he thought he had found the trouble. He tapped the throttle box with a hand hammer and there was considerable difference in sound on opposite sides. He struck it a sharp blow and broke a three-cornered piece out of it. The casting at this point was only $\frac{3}{16}$ in. thick and investigation showed the opposite side to be $1\frac{1}{2}$ in. thick. In pouring the casting the core had got out of center, causing this condition. Under full boiler pressure and temperature the throttle seat went out of round causing the leak.

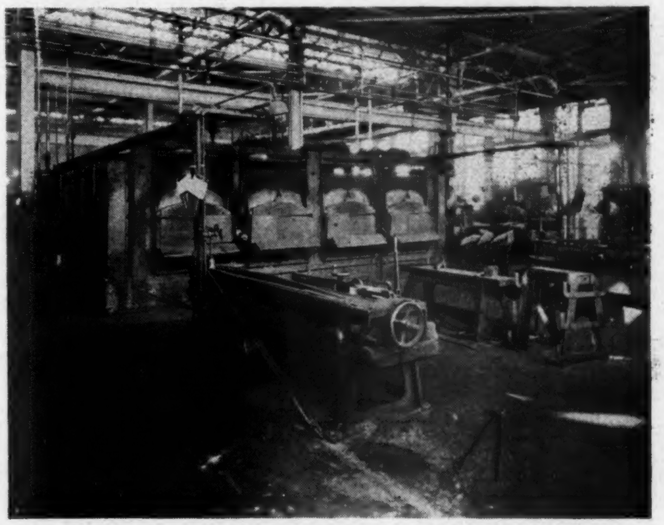
Spring Manufacture At Altoona Shops

By J. B. Nealey*

At the Pennsylvania's Altoona, Pa., shops, one entire shop is employed in the making and repair of springs—mostly flat springs. These vary considerably in width, thickness, length and number of leaves, and are forged from spring-plate stock.

Spring leaves are heated three times, first for forming, second for hardening, and third for drawing. Some are also heated on the ends for nibbing, slotting and trimming. The furnaces are of brick and refractory construction and encased in steel. The two forming furnaces are each 7 ft. by 6 ft. by 18 ft. long and have four doors on the front side, so that the stock can be put in and removed hot from the same side. A row of cast-iron pegs rises above the hearth, along its middle line, and the leaves are placed on edge between these. There is a narrow charging platform and the doors are raised mechanically by tilting a section of this platform. Heat is supplied by 10 gas burners located in the back wall of the furnace.

When heated to approximately 1,800 deg. F. the stock is removed and formed or cambered in the forming machine. This consists of a heavy cast-iron base supporting a chain between pegs. In front is a steel form, curved to conform to the arc of the camber and fixed rigidly to the piston of a hydraulic cylinder. The hot stock is put between these and the cylinder forces it against the chain forming it to the right camber. The leaves are then piled on edge in complete spring assemblies on buggies with sloping tops. These are rolled over to the heat-treating section after allowing sufficient time to cool to black or lower temperature.



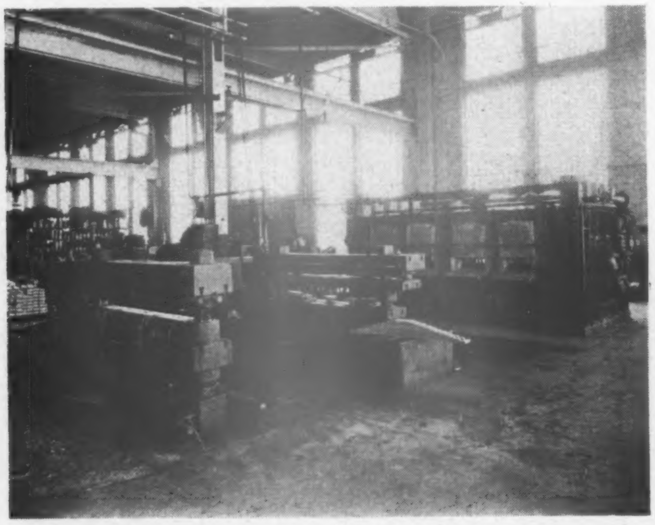
The spring leaves are formed at this location

Hardening furnace, salt baths and quenches—Both the oven type furnaces and the salt baths are fired with gas fuel

The quenching heat is acquired in furnaces (there are two) of the same size as those already described. These furnaces have four doors in each side so that the

* American Gas Association, New York.

leaves can be put in from one side and pulled out from the other. Heat is supplied by ten gas burners, five in each side and located between the doors and the spaces beyond the two end doors. The burners of all the



Nibbing furnace and press

furnaces are of the inspirator type, each being equipped with a venturi tube. Pressure gas inspirates air in the proper ratio for perfect combustion. The doors are counterweighted and are operated with pneumatic cylinders. A row of pegs occupies the center line of the hearth. It formerly was the practice to lay spring leaves flat in the furnace, after being cambered, but when heating the leaf to the hardening temperature it would lose its camber by virtue of its own weight.

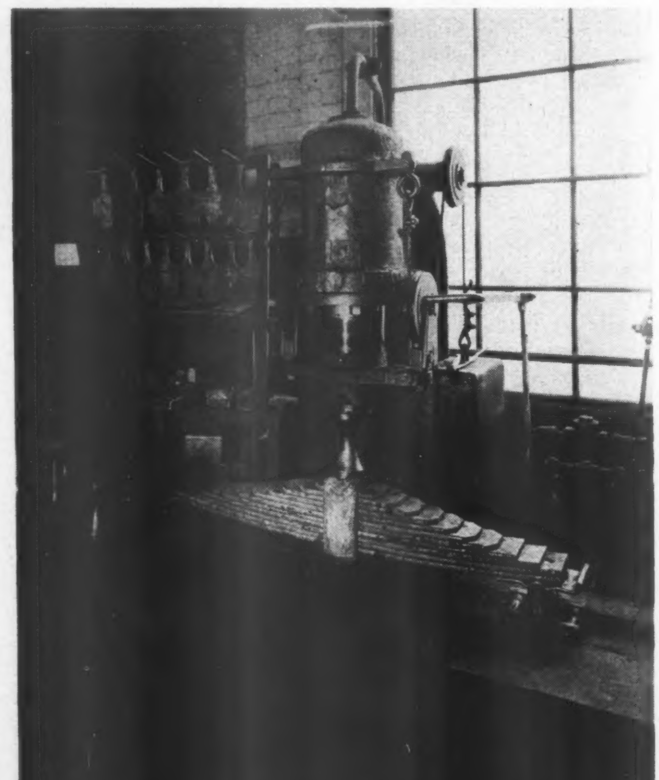
When heated up to 1,500-1,550 deg. F. the leaves are quenched in oil in a row of four steel tanks in the rear of the two hardening furnaces. There is one quenching tank in the rear of each pair of furnace doors. Each tank is 4 ft. by 7 ft. and is equipped with a steel basket with upright spindles between which the leaves are placed. Overhead monorails and hoists transfer the baskets of

After assembly the springs are banded in this machine

work between the next two operations consisting of drawing and water rinsing. Next to and end to end to the four quenching tanks are four salt baths or kettles set in as many furnaces. The steel kettles are 4 ft. by 8 ft. by 2 ft. deep, and each furnace is fired with two gas burners set in opposite corners and underfiring the kettles. The salt bath consists of a mixture of sodium nitrate and sodium nitrite.

Leaves are quenched in an oil bath in a vertical position and placed in baskets between pins separating the leaves, permitting the free circulation of oil around them and eliminating gas pockets. After the leaves have been quenched the basket is placed in the salt bath, and again this spacing of leaves is of particular advantage as it permits a more uniform draw.

The leaves are reheated to 800 deg. F. in the salt bath and held there for a sufficient time for thorough penetration and are moved to another row of 4 ft. by 7 ft. steel tanks containing water. This acts both as a quench and as a rinse to wash the salts from the work. The leaves



An elliptic spring under the testing machine

are then piled in spring sets on slope-topped buggies.

The final setup requires two gas-fired furnaces, a press for bending bands, and a forging machine for welding the band ends together. The first furnace is 2 ft. wide and 6 ft. long and is heated with a gas burner in each end. It has a slot in the top and this has a refractory baffle suspended just above it. The band stock is of wrought iron or open-hearth welding steel, heated here and formed into U shape in the first hydraulic press. The bands are then reheated and the two ends are turned and lap welded in the forging machine. The second furnace is 2 ft. by 4 ft. in cross section and 6 ft. long. It has four openings in front through which the partially formed bands are thrust for end heating. A single gas burner in each end supplies the heat. These burners are of the pre-mix type and an air blower is part of the combustion equipment. Close by is the assembly bench and as soon as the leaves are put together in spring assemblies the bands are put on hot.

Springs are banded in a 600-ton three-stroke hydraulic press, water being applied during the banding operation to shrink the band into place.

During the banding operation the spring is stenciled

indicating the class of spring, date banded, shop in which repaired and bander's number, so that any defects in banding can readily be traced to the operator who performed the work.

The springs are then carefully gaged for dimensional correctness, tested for free load, maximum load and permanent set, dipped in oil for lubrication and then are either stored or shipped. A large section of the building is given over to storage. Here long parallel lines of steel rails are laid on the floor and the spring assemblies are piled on these. Several parallel overhead monorails with hoists are used to handle them.

Combination Gas and Oil Burner

A combination burner, designed for using either natural gas or oil fuel in railway shop furnaces, has been installed and successfully used, as shown in the illustration, at the Atchison, Topeka & Santa Fe shops, Albuquerque, N. M. The particular view given shows the application of the burner to a large furnace in the blacksmith shop, but two others have also been equipped.

Draft to this furnace is furnished by force blast through an 8-in. header pipe *H*, from which the draft is supplied to the bottom of the furnace through two 3-in. pipes *AA*, one on each side of furnace. This draft lifts the flame over the brick bridge wall and is used when burning either gas or oil.

When using natural gas, the gas is delivered through a 1½-in. gas pipe *G* and a regulating valve in this line at 15 lb. pressure, this pressure being reduced to 5 lb. after the furnace becomes hot. Gas line *G* enters blower pipe *B* at mixing chamber *C*, where it is mixed with air from header pipe *H*. Mixing chamber *C* is so constructed that, in case of a failure of the blower fan, the natural gas cannot pass down into header pipe *H*. Lever *D* in the blower pipe under mixing chamber *C*

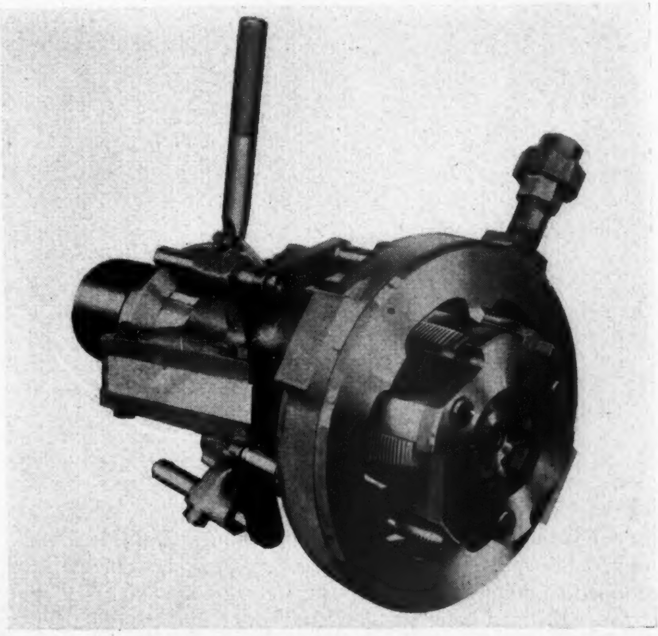
Combination natural gas and oil burner used on large furnace at the Albuquerque shops of the Santa Fe

controls the amount of air passing into mixing chamber *C*, which must be kept within definite limits. Natural gas and air is forced through 4-in. blower pipe *B* into the square regulating chamber *R* which contains a nozzle burner regulated by needle valve *V*.

When using oil instead of natural gas, the valve in line *G* is closed and oil, supplied by a 1¼-in. line passing through heater coil *S*, is reduced by a T-fitting to the ½-in. oil line *O*. Entering the top of square chamber *R*, oil is regulated by valve *T*. It is necessary to change the burner nozzle in chamber *M* when using oil; however, the blast is supplied in the same manner as when burning natural gas. It will be noted that duplicate gas and oil lines are provided, one on each side of large furnaces like the one illustrated.

Oil-Type Trip Ring For Collapsible Taps

When tapping threads, particularly long threads of large diameters in steel, it is essential to maintain ample lubrication to dissipate the heat and wash away the chips. To insure a sufficient supply of lubricant for its line of collapsible taps the Landis Machine Company, Waynes-



Landis 6-in. Style LM receding-chaser collapsible tap with oil-type trip ring

boro, Pa., has placed on the market an oiling type of trip ring to replace the conventional type of ring usually employed on a collapsible tap. The illustration shows one of these rings applied to a 6-in. Landis Style LM receding-chaser collapsible tap. The ring consists of a hollow housing with steel plates mounted on the front and the back, thus forming a reservoir for holding the lubricant. On the smaller sizes of rings the housing is made of cast iron and in order to lessen the weight the housing for the larger rings is made of aluminum. The front ring which contacts the work to effect the receding and collapsing action of the tap is made of steel and case carburized to resist wear.

Holes are placed diagonally in the housing through which a stream of oil is forcibly directed upon each chaser throughout the entire length of the cut, thus insuring ample lubrication at the point where it is needed. A supply pipe with union connection is provided for attaching the supply hose. The housing of the trip ring remains stationary while the front and back plates turn with the tap if it must revolve for tapping the thread.

These rings are available for use with Landis Style LM receding chaser and Style LT collapsible tap, 6 in. in size and larger.

Evans looked up and swallowed his chew of horseshoe. It was the government inspector

Uncle Sam on the Job

by Walt Wyre

JIM EVANS, roundhouse foreman for the S. P. & W. at Plainville, was making out his engine line-up for the day. "Now, let's see," he reflected as he chewed the end of a pencil. "We can use the 5094 on No. 10. The 5071—I'll run her east on the short end; have to run her over the drop-pit soon as we get the 5087 off," he mused, "driving-boxes are worn past the limit and she needs a new set of tires. Now, that finishes the passenger trains but don't leave much for the freights."

"What you got for 81 and 82?" John Harris, the roundhouse clerk asked.

"When are they doped in?" Evans replied.

"Oh, 81 is figured to get here about three o'clock; 82 ought to make it sometime before midnight."

"Well, if there's not too much on the hog that comes in on 81, we'll just have to make her for 82. I've got two 2800's that ought to be ready for a fire long about three or four o'clock. That just leaves one extra 5000, the 5092, and she's made her mileage long ago and ready for the back-shop. Anyway, here's the list; you can give it to the dispatcher along with my best wishes."

Harris reached for the telephone, but before he lifted the receiver the bell rattled noisily. "Hello . . . Yes, clerk talking." Harris winked at Evans and the foreman knew it was the dispatcher calling. "Yeah . . . Mr. Evans? He's right here." The clerk placed his hand over the mouthpiece. "Train delayer wants to talk to you, Mr. Evans."

"Hello . . . Yes, this is Evans."

"How about a 2800 for an extra west?" the dispatcher asked.

"What time do you want it; and what kind of a train are you going to have?" Evans asked the dispatcher.

"If you'd put in as much time working on locomotives as you do trying to figure how to get them to the other end of the division before they fall to pieces, you wouldn't need to ask what kind of train."

"Well, if you're through making a speech, you might kinda intimate whether you want that hog today or tomorrow," Evans replied sarcastically.

"Well, let's see; it ought to be showing about eleven o'clock, say eleven-thirty. I'll call you back in a little bit and give you something definite. What engine you going to give me?"

"It'll either be the 2870 or 2845. I've got to change a pair of trailer wheels on the 2870 and the 2845 has got the rods down. I'll see which I can get first and let

you know when you call back to let me know when you want it."

"Better call me soon as you find out whether you can get either of them ready or not. How about an engine line-up for the regular trains?"

"The clerk'll give it to you," Evans replied and handed the receiver to Harris.

Evans bit off a hunk of "horseshoe" and hurried out to the roundhouse to see how things were looking. The 2870 had to be run over the drop-pit to change the trailer wheels and had no steam. It would take some time to snake the engine out and shove it over the pit, besides the hostler was busy taking engines around and getting them ready for trains that were called. The 2845 could be worked where she stood and fired most any time. She had more work on her than the 2870, but could probably be gotten out sooner. He decided to use the '45. Machinist Cox and his helper were already working on one side of the engine. The foreman put a machinist and helper on the other side, took a turn through the roundhouse, and went back to the office.

Evans had just settled down comfortably and was looking over work reports when the phone rang. It was the dispatcher.

"Well, what about a hog for that drag?" the dispatcher asked.

"It'll be the 2845. What time is she called for?"

"Eleven-fifteen. Who's the engine crew?"

"Johnson and Murdo." Evans glanced at his watch, eight-thirty-five. "Can't you give us a little more time on it?"

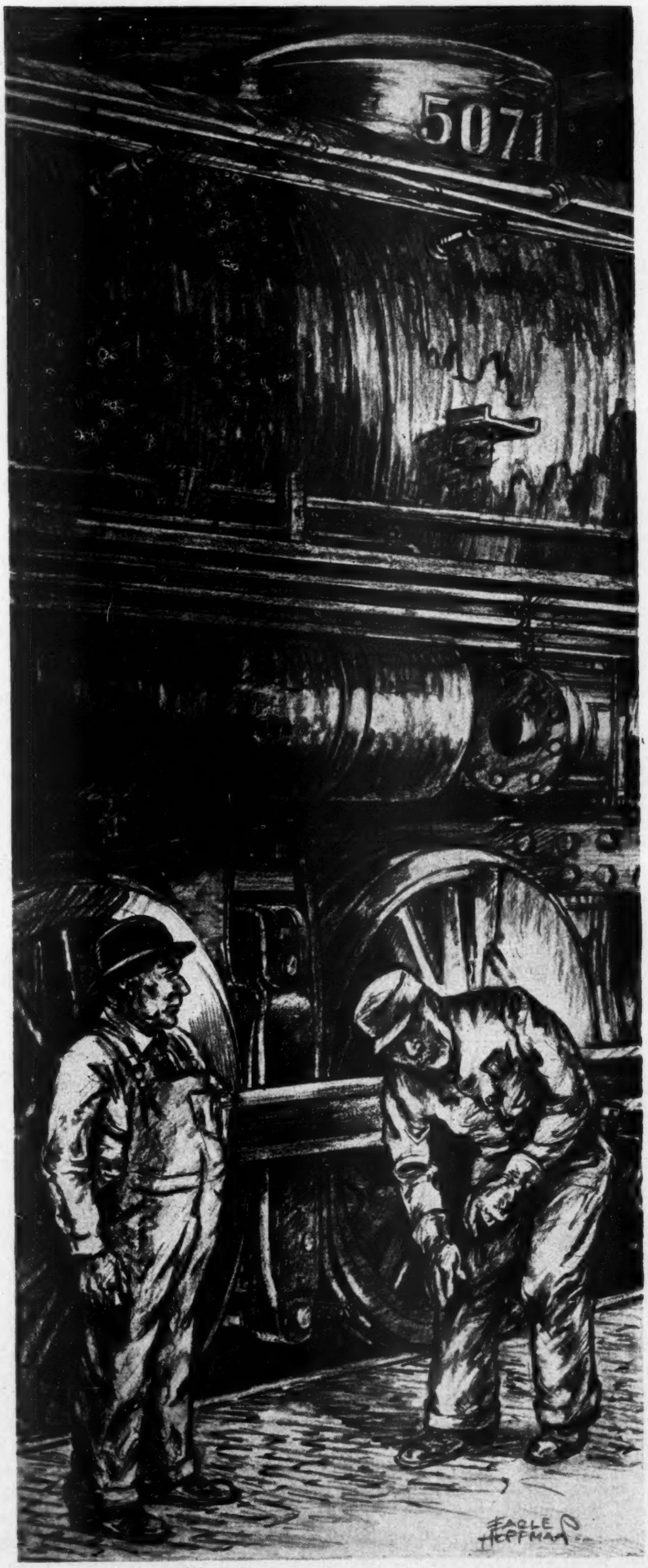
"Nothing doing," the dispatcher replied. "If you'd try having a few engines ready you wouldn't need more time. You ought to know by now that we occasionally use one to pull a train."

"Yeah, and if you'd try guessing right occasionally, we might know what you wanted." Evans grinned as he hung up the receiver.

The foreman again settled himself comfortably and began to look over the work reports trying to figure out what jobs had to be done and ones that could ride another trip. Doing everything that needed to be done was out of the question entirely. Not enough engines to hold them until the work was finished and not enough appropriation to pay the extra men that would be required to do the work if he could.

He had just about finished going over the work reports when the office door swung open. Evans looked up and swallowed his chew of "horseshoe." It was the government inspector.

Jim shoved the work reports aside and rose. The foreman was smiling as he advanced with outthrust hand to greet the government inspector, but the smile was more like the ones seen painted on wax dummies in show windows than of pleasure. Of course the cud of well masticated chewing tobacco doing somersaults in Evans stomach didn't help his feelings. Added to the fact that half the engines he figured on running bore defects that rated a Form 5 if the inspector wanted to get technical about it, Jim wished for a convenient hole to drop in. The way he felt, the hole wouldn't need to be a very large one, either. He felt low enough to walk under a pilot standing up without bumping his head.



He rose and dusted off his knee with a gloved hand. "Looks like too much travel on the driver brakes," he announced

"Well, well, Mr. Turner, wasn't expecting you right now. Glad to see you," Jim lied with the best possible grace under the circumstances. "How are you?"

"Pretty well, thanks, Mr. Evans; managing to keep going and stay pretty busy. How are your engines? How's the spring rigging on them? Last time I was here some of them were in pretty bad shape. Driving-boxes on some of them worn pretty close to the limit, too," the inspector added as he took off his coat and began to put on a suit of unionalls.

The mention of driving-boxes sent a chill down Evans' spine. He thought of the 5071 marked up to run and the 5092 worse than the 5071, if anything, and the 2845. If Turner happened to get started on driving-boxes, the few trains run that day would be bothered very little with meet orders. It was sure one grand time for a government inspector to show up.

"How's the motor car?" Turner asked as he wiggled into his unionalls. Gas electric cars had only been under the government inspector's jurisdiction for a few months.

"Oh, she's all right, I guess," Evans started to add "tied up waiting for a pair of wheels" but changed his mind.

The foreman stood nervously first on one foot then on the other while the government inspector leisurely buttoned up his unionalls then put on a cap and stuck a pair of gloves in a hip pocket. Evans knew Turner. If he, the foreman, appeared to be trying to keep the inspector out of the roundhouse, Turner would be in a bigger hurry to get there. Jim was too sick to stand and afraid to sit down. His stomach was on strike protesting the use of chewing tobacco as food.

The inspector finished dressing and fished a flashlight from his handbag. That was usually a signal to start for the roundhouse. Jim breathed a sigh of relief for a momentary respite when Turner sat down.

Jim sat down also. "What do you think of the Townsend Plan?" he asked hoping to get the inspector talking. Long as he stayed in the office the inspector wouldn't be finding defects on locomotives.

"Looks like a pretty big issue," Turner replied without interest. "Did you get specifications on making insulation resistance tests on the motor car?"

"Yeah," Evans replied holding his head up with an effort and trying to appear interested. "We've about got straightened out on the motor car. How you finding things over the railroads; conditions any better?"

Machinist Cox who had been working on the 2845 came in at that instant slightly out of breath. "Say, Mr. Evans, there's a crack in the right main pin of the 2845."

"Sure it's a crack?" the foreman asked dolefully.

"Yeah, I 'm sure, that is, pretty sure." Cox had just recognized the government inspector.

"Well, I'll go take a look at it." Jim was glad of an opportunity to get out in the fresh air. "Want to go look at it, Mr. Turner?"

"I'll be out in a little while; going to look the motor car over directly; go ahead."

The main pin was cracked, no argument about it. A hair line of grease showed through the coating of whiting and alcohol with which the machinist had painted the pin. The crack was right up against the fillet on the main rod fit towards the wheel. Not much of a crack, to be sure, but enough for a starting place for the pin to snap off and cause a nasty failure, to say nothing of tying a knot in main and side rods, knocking off the air reverse cylinder, breaking a guide yoke, driving a piston through the cylinder head, perhaps injuring the engineer, or wrecking the train. Any or all of them could happen when a main pin broke with an engine traveling full speed.

"Well, burn it out and tell one of the machinemen to start to work on a new one." Jim's stomach gave a tumultuous heave and he headed for the office.

"Dispatcher said to call him," the clerk told the foreman.

Evans grunted and kept going, headed for the toilet. If he had been a surveyor he couldn't have estimated the distance he could have gone better. One more step and the janitor would have had a job. After unloading the chew of tobacco along with his breakfast and, as Jim thought, part of his interior mechanism, he felt better but his stomach felt emptier than it really was when he remembered about calling the dispatcher. That worthy seemed exceptionally busy when Jim called. Jim waited uneasily nearly five minutes before the dispatcher answered, then instead of the usual line of banter he said, "Be one o'clock on that drag," and hung up.

Another reprieve, short but sweet. Jim went back to the roundhouse and told the fire builder to get the 5092 hot. He located the hostler and told him to get the 2870 over the drop-pit. At that, the best he could hope for was a couple of hours delay getting the engine ready for the extra. By the time the hostler had shoved 2870 over the drop-pit it was time to get the 5071 out for the eastbound fruit train.

"The fool ought to have sense enough to drag the brakes a little to keep them boxes from pounding," Evans muttered to himself as the hostler brought the 5000 around sounding like a couple of boilermakers in a boiler on payday. The foreman went over to the motor car half expecting Turner to walk over and tie up the 5071 where it stood waiting for the engine crew. He found the inspector puttering around the motor car.

"Want to take a look at the 5071?" Evans tried to appear as though nothing could please him more.

"Just a second, believe I will."

The foreman didn't know whether to write his resignation then or wait until instructed to do so. He decided to wait at least until the 5071 had a Form 5 hung on her. The inspector walked slowly around the locomotive. He didn't appear to be examining anything but Jim knew from experience that his trained eyes were seeing lots—too much, in fact, for the foreman's peace of mind.

Turner stopped. He dropped on one knee between number two and three drivers. Out came his flashlight.

"Take that engine back over the inspection pit," Jim expected to hear him say.

He rose and dusted off his knee with a gloved hand. "Looks like too much travel on the driver brakes," he announced and Evans breathed again.

"I'll have them taken up right now. Like to go out in the house and look over a few?" he added.

"Nearly lunch time now," the inspector replied. "We'll look at them after lunch," he said and started towards the office.

Evans went back to the roundhouse to see how things were coming along there. If he could just get the 5092 out of town, things wouldn't be so bad, especially if Turner finished his inspection before 81 and No. 10 got in. Locomotives on neither of them were exactly in shape for inspecting and if the inspector reported work to be done it would be a good idea to do it before running the engines again. That was another thing Evans had learned from experience.

Jim decided to run the 5092 on the extra. By lingering a little with Turner at lunch there was a chance the engine would get out of town before the inspector had an

opportunity to look it over. It was worth a trial, anyway.

The dispatcher had to be notified of the change. How to get Turner out of the office was another problem. He might accidently get curious. Government inspectors sometimes do when a foreman decides to run an engine that wasn't marked up to run and hasn't been inspected. Evans wrote a note to Harris explaining the situation and instructing him to call the dispatcher after Jim and the inspector had left.

The dispatcher came very near wrecking the plan by calling before Evans and Turner left, but he saved the day in another way.

"They're picking up eight cars of cattle and will want a 5000 for that extra," the dispatcher told him.

"Well, that will be fine," Evans replied.

"I can give you another hour on it if necessary, changing engines on such short notice."

"No, that's O.K.," Evans replied and glanced over at Turner to see if he was listening. If he was he didn't show it.

The dispatcher was so amazed for the moment to find the foreman ready and even anxious to give him an engine on such short notice he almost forgot to ask the number.

"All right, then, called for one o'clock. What's the number?"

The dispatcher was more amazed when Evans replied, "Oh, yeah, that'll be O.K., just like I told you," and hung up. He handed the clerk the note he had written and winked broadly before turning to the inspector.

"Well, are we ready to go eat?"

"I am, but aren't you going to change clothes?"

"Guess I'd better, at that," Evans replied and begain to peel off his overalls at a speed that would have made a fireman jealous. In his anxiety to get the inspector out of the office he had forgotten about taking off his overalls and washing. That didn't delay them much, however, and they were on their way shortly after the noon whistle blew.

The telephone was again rattling insistently as they went out the door. Evans knew it was the dispatcher and knew what he wanted. He pretended not to hear when Turner called his attention to the fact that the phone was ringing.

SMOKE of the 5092 could be seen in the distance when the foreman and government inspector reached the roundhouse after lunch. Things weren't entirely in the clear, though. There was still a dozen or so locomotives marked up to run, any one or all of which could be tied up for Federal defects. True, some of the defects were very slight, but then sometimes inspectors are very critical and become arbitrary over such things as hand rails not clearing over two inches, steam leaks in dynamo heads, clear vision glasses improperly adjusted, and a thousand and one little things that ordinarily they will pass up with casual mention.

They started out through the house about one-thirty, the inspector leading the way, Evans following. As Turner mentioned defects and noted them in his book, Evans wrote them down in a book he carried. The government inspector pointed out defects on engines that the foreman hadn't noticed. At the same time he failed to mention quite a few that Evans knew existed. Occasionally Jim called his attention to defects always adding that it was to be repaired before the engine would be used. Jim knew he wasn't fooling the inspector any and the inspector knew that Jim knew it, too. They had both been on the job too long for either of them to fool the other—much.

(*Concluded on page 173*)

Diesel Engine Questions and Answers

21.—*Q.—Should the heating coils in a fuel oil tank have any joints?* A.—No. Threaded joints in the heating coil of a fuel tank might leak, allowing water to get into the fuel.

22.—*Q.—What parts of a Diesel engine are the most frequent causes of trouble?* A.—The fuel injection system. The parts of this mechanism take the place of the complicated carburetion and ignition systems of gas engines. By the injection apparatus the timing of the ignition is accomplished.

23.—*Q.—Why are slip joints rather than threaded joints used on the exhaust pipes and mufflers of gas engines?* A.—Slip joints on exhaust piping provide for expansion and contraction.

24.—*Q.—What unusual provisions are made for cooling Diesel engines?* A.—In addition to the cylinder water jacket an oil cooler for the lubricating oil is often used, and on the larger engines oil or water is used to cool the pistons. On some engines the exhaust manifold is water cooled.

25.—*Q.—What is meant when a pump is said to be air locked?* A.—If a pump (for handling liquid) is air locked the body of the pump is full of air which expands and contracts with the operation of the pump. This prevents the valves from working and stops the operation of the pump. Some Diesel fuel pumps are subject to air lock, and provision is made to remove the air by flooding the pump with oil. Air lock is apt to be present after repairs to the pump or piping.

26.—*Q.—What causes the cylinders of a gas engine to wear tapered?* A.—Diesel cylinders wear tapered because there is more pressure under the cylinder packing rings at the compression end of the stroke. When at the crank end of the stroke the cylinder pressure is less and the rings do not set out so firmly against the cylinder wall. Also, high pressure at the compression end of the cylinder causes the piston to press the cylinder wall tightly due to the angularity of the connecting rod. The Diesels used in railway practice have no crossheads.

27.—*Q.—Are step-joint rings superior to diagonally-cut rings?* A.—There is a difference of opinion about the relative merits of different cylinder packing rings. Step-joint rings do not blow through the joint, but like diagonally-cut rings there is some blow of pressure from behind the rings which comes out of the opening at the joint. The thin ends of step-cut rings often break off in service.

28.—*Q.—What is the limiting factor in designing a gas engine for the maximum possible revolutions per minute?* A.—In designing for high speed great difficulty is found in scavenging the burnt gases quickly and completely. This is the reason for superchargers and supplementary exhaust ports sometimes used.

29.—*Q.—Trace the path of lubricating oil through the system of a Diesel engine.* A.—From the sump tank the lubricating oil passes through a strainer to the pump suction, through the pump, through another strainer, through the oil cooler, through the oil lines to the main bearings. It then passes through a hole in the journal of the crank shaft to the center of the shaft, through the shaft to the crank journals, up through the centers of the connecting rods to the piston pins. Oil leaks out of each bearing and falls to the bottom of the crank case where it flows back to the sump tank.

30.—*Q.—What does a supercharger in connection with a Diesel engine accomplish?* A.—A supercharger

operates to put more air into the cylinder by providing a cylinder full of compressed air at the beginning of the stroke instead of air at atmospheric pressure. Since there is more air in the cylinder, if enough fuel is injected the cylinder can develop more power than without the supercharger. The supercharger therefore will enable the power of the engine to be increased, because more air for the combustion stroke is supplied. It does not necessarily increase the efficiency of the engine. Supercharging is particularly desirable when the engine is working in a rarefied atmosphere because it will enable a greater charge of air to be taken in and thus keep up the power. Supercharging is resorted to in aviation engines which operate at high altitudes and this device reduces the power reduction that would otherwise be experienced due to the reduced amount of oxygen present in the charge at high altitudes. A supercharger is useful in giving a reserve of power whenever this may be required. Supercharging may serve to increase the power of an engine at sea level as much as 30 per cent or will give its rated power at an altitude of about 5,000 ft.

New Hy-Draulic Planer Is Announced

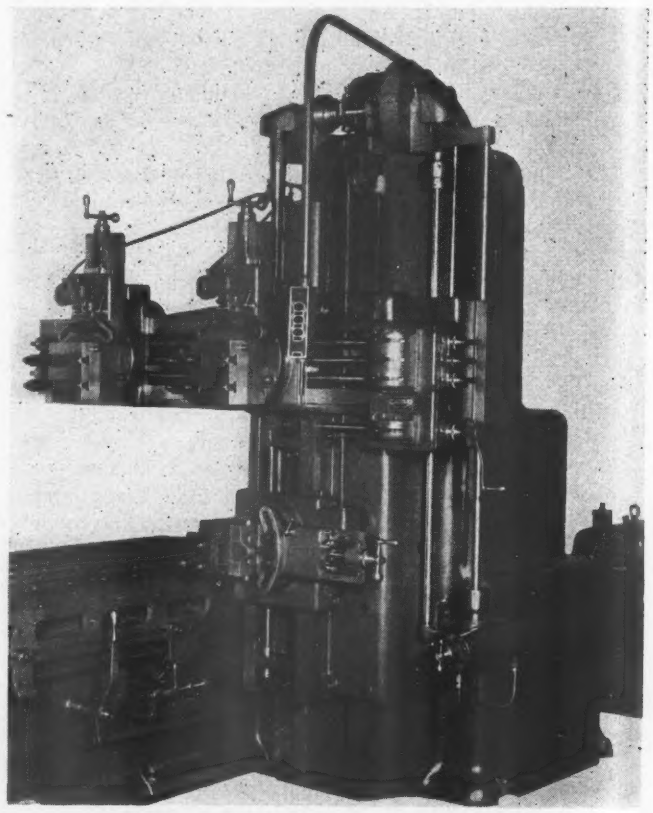
The Rockford Machine Tool Co., 2500 Kishwaukee Street, Rockford, Ill., is now building the Rockford Hy-Draulic planer, in a much larger size than has heretofore been available.

Referring to the illustrations, it will be noted that the "power house" for the machine is at the right-hand end of the bed. This comprises the main driving motor directly connected to the hydraulic power unit, both mounted on a heavy base, and all solidly secured in position. This compact, efficient arrangement is designed to reduce the number and length of the necessary hydraulic connections, eliminate vibrations, provide complete protection, accessibility, and ample ventilation. Hand-wheels on either side of the hydraulic power unit enable the operator easily to adjust cutting speeds and the rapid-return rate.

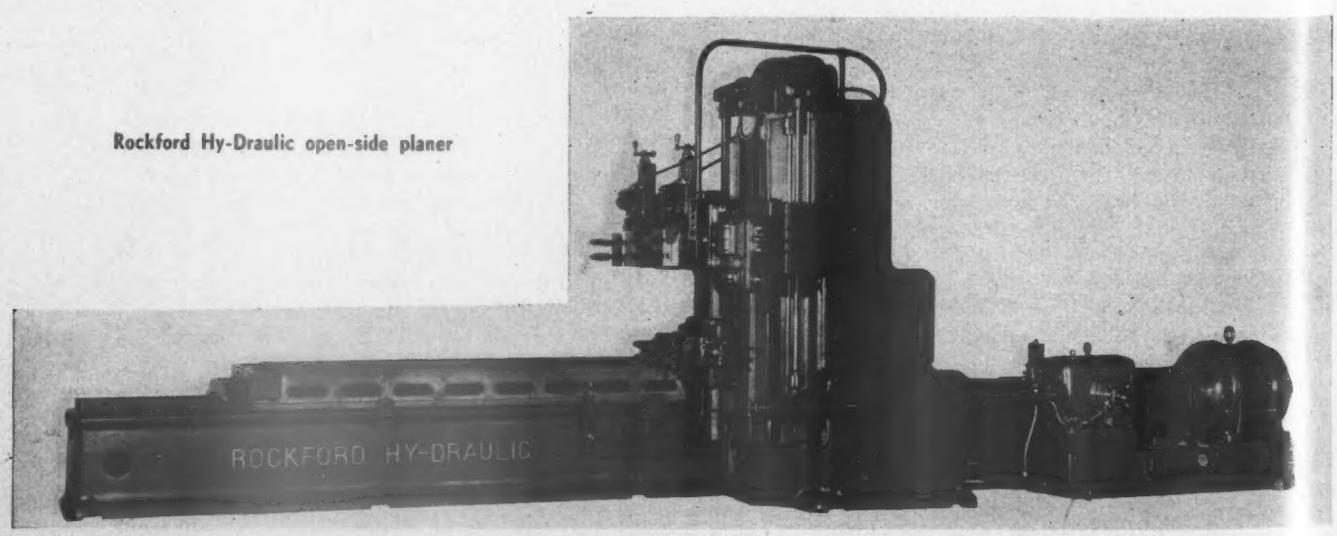
The double-length box-section bed has heavy ribbing throughout. The table also is box section and has the customary T-slots, hold-down holes, adjustable control dogs, clean-out openings, chip pocket and tool tray at one end with double oil-wipers at both ends for both ways. The table never overhangs the bed.

In the center of the machine, there is a massive column which supports the open-side crossrail and contains the electrical and hydraulic control panels. Mounted on top of the column is a motor-driven mechanism which provides rapid traverse to all heads and power elevation for the rail. A large inverted L-shaped casting includes, in one piece, the cross-rail and its long vertical bearing on the column. Securely mounted on this slide is the side-head rail which is pivoted at its upper end and provided with a fine adjustment at its lower extremity. This construction provides a permanent means for accurately aligning the side-head rail which is then solidly secured in position by heavy bolts.

Operating controls are centralized and conveniently located. A pendant contains push-button controls which establish the direction of rapid traverse for the rail-head. a master motor switch, and a rod by means of which the machine can be stopped instantly. Three levers provide complete control for the power-operated

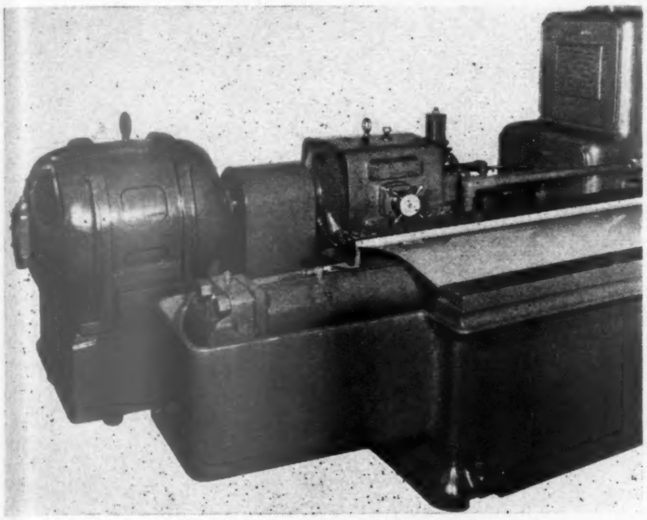


A massive column supports the cross-rail



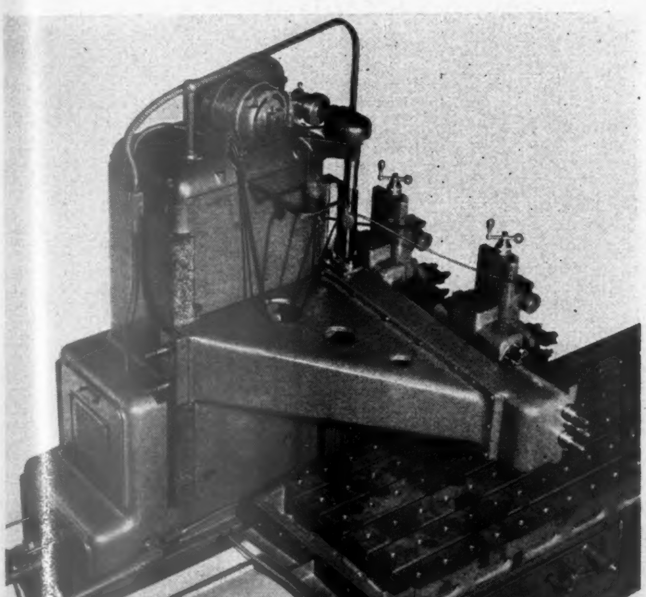
Rockford Hy-Draulic open-side planer

movements of both rail-heads including feed or rapid traverse to left or right, up or down, separately or in unison. A lower lever performs the same service for vertical movement of the side-head. By means of a



Power-house end of the planer

ball crank near the base of the column, the operator can secure instantly any desired feed rate within the capacity of the machine. A lever on the side of the base starts and stops the table movement and an adjacent lever reverses its direction. The rail-heads are equipped with automatic tool-relief devices which raise the tools out of contact with the work during the return stroke. Duplicate controls for starting, stopping, and reversing the table movement are provided on opposite sides of the machine. A heavy sheet-metal cover is



The overhanging cross-rail is firmly braced

provided between the ways which extends the whole length of the bed underneath the table.

The following are general specifications for the machine illustrated:

Maximum pull to table	24,0000 lb.
Maximum distance from table to underside of cross-rail	37½ in.
Length of bed (optional)	23 ft. to 45 ft.
Length of table (optional)	12 ft. to 22 ft.
Width of table	36 in. or 42 in.
Center to center of ways	18⅝ in.
Horizontal adjustment of side-head slide	11 in.
Down adjustment of rail-head slide	11½ in.
Cutting speeds of table per min. (optional)	0 to 50 ft. or more
Return speeds per min. (optional)	10 ft. to 150 ft. or more
Horizontal feed of rail-head	1/42 in to ½ in.
Vertical feeds of rail-head	1/96 in. to ¼ in.
Vertical feeds to side-head	1/48 in. to ½ in.
Horizontal feeds to side-head	Extra

Uncle Sam On the Job

(Continued from page 171)

When the inspector crawled down in the pit under the 5094 Evans just knew he was sunk. It was the only engine available for No. 10, the Limited, for when Turner went under an engine he usually came out with a Form 5 in his hand. This time was an exception.

"Looks pretty good underneath," the inspector said and Jim almost fainted.

"Well, let's go out to the motor car," the government man said.

After inspecting the motor car, the foreman and inspector went back to the office. The inspector began to pull off his unionalls. That meant that he had finished, but it didn't mean what the finish would be. He put away his work clothing and sat down at the desk, Evans sitting across from him. The inspector's black book lay on the table between them. Nearby a well worn brief case lay on the desk, its open side turned so that Evans could see books and papers. One of the pads of paper was blue. Evans had a pretty good idea that up in one corner in small letters was printed "Form 5," the form used to tie up a locomotive until defects were remedied and the locomotive again "safe and suitable for service." Turner filled his pipe, lighted it and puffed until the rough cut was burning evenly.

"When you figuring running the motor car?"

"Not until we get a new pair of wheels for the front truck," Evans replied.

"Yeah, I noticed those wheels. Here's a list of repairs that should be made. Guess I'll go up to the hotel and make out my report." Turner closed the brief case and shook hands with Evans who was congratulating himself on getting away with things in good shape.

"And by the way, Jim. I didn't inspect any driving-boxes *this* trip and the 5092 got out of town before I had a chance to look her over. So-long."

Evans breathed deeply as he watched Turner walking towards the station. "Thank the Lord for a government inspector with sense," he murmured aloud.

At the same time he knew the inspector had accomplished what he intended to do and knew it. Next trip he'd look at driving-boxes, and they'd be O.K., but something else that wouldn't stand close inspection Turner wouldn't get around to. But pity the foreman that didn't take a tip and get the work done. Form 5's would be thicker than automobile salesmen after ex-service men next July.

Historic Locomotive—The London & North Eastern of England has just withdrawn from service a locomotive that was constructed in 1891 in the record time of 9¾ hr. This example of record building was intended to demonstrate how quickly a locomotive could be put together. The engine compiled 1,127,750 miles before being consigned to the Davey Jones' locker of railroads.

Among the Clubs and Associations

WESTERN RAILWAY CLUB.—G. E. Scott, purchasing agent, Missouri-Kansas-Texas, will speak on Purchases and Stores at the meeting to be held on April 20 at the Hotel Sherman, Chicago. A reception and dinner will precede the meeting, which will begin at 8 p.m.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. N. Kelly, manager, United Fruit Despatch Company, will discuss the development of the refrigerator car and its use in banana industry before the meeting to be held at the La Salle Hotel, Chicago, at 8 p.m. on April 13. There will also be moving pictures, with sound equipment.

PACIFIC RAILWAY CLUB.—At its meeting in the Palace Hotel, San Francisco, on March 12, the following officers were elected to serve during the club's twentieth anniversary year: President, Roy W. Hunt, fuel supervisor, Atchison, Topeka & Santa Fe; first vice-president, Homer Bryan, locomotive engineer, Western Pacific; second vice-president, Stuart Daggett, Professor of Transportation, University of California; treasurer, William P. St. Sure, vice-president, East Bay Street Railways, Ltd., and Key West System, and secretary, William S. Wollner, who has served the club as executive secretary since the organization of the club. W. H. Kirkbride, chief engineer of the Southern Pacific, who retired as president, was presented with a past president's locket in appreciation of his services to the club. In addition to the installations there was an illustrated address on Making Railroads and Railroadmen Safe by A. A. Lowe, supervisor of transportation, Southern Pacific.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings and places of meetings of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, c/o Westinghouse Air Brake Company, 3400 Empire State Building, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton, Crane Company, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—C. E. Davies, 29 West Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, 192 East Cedar street, Livingston, N. J.

MACHINE SHOP PRACTICE DIVISION.—G. F. Nordenholt, 330 West Forty-second street, New York.

MATERIALS HANDLING DIVISION.—F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

OIL AND GAS POWER DIVISION.—M. J. Reed, 2 West Forty-fifth street, New York.

FUELS DIVISION.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

ASSOCIATION OF AMERICAN RAILROADS.—J. M. Symes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.

DIVISION I. — OPERATING. — SAFETY SECTION.—J. C. Caviston, 30 Vesey street, New York.

DIVISION V.—MECHANICAL.—V. R. Hawthorne, 59 East Van Buren street, Chicago.

COMMITTEE ON RESEARCH.—E. B. Hall, chairman, care of Chicago & North Western, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey street, New York.

DIVISION VIII.—MOTOR TRANSPORT.—CAR SERVICE DIVISION.—C. A. Buch, Transportation Building, Washington, D. C.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEER.—Jos. A. Andreucetti, C. & N. W., 1519 Daily News Building, 400 West Madison street, Chicago, Ill.

CANADIAN RAILWAY CLUB.—C. R. Crook, 2271 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month, except in June, July and August, at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT OFFICERS ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago, 7926 South Morgan st., Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—J. R. Leach, car department, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month at 1:15 p.m. at Union Pacific shops, Council Bluffs.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—E. G. Bishop, Illinois Central System, East St. Louis, Ill. Regular meetings third Tuesday in each month, except June, July and August, Statler Hotel, St. Louis, Mo.

CENTRAL RAILWAY CLUB OF BUFFALO.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

EASTERN CAR FOREMEN'S ASSOCIATION.—E. L. Brown, care of the Baltimore & Ohio, St. George, Staten Island, N. Y. Regular meetings, fourth Friday of each month, except June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p.m.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—T. D. Smith, 1660 Old Colony Building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 West Wabasha street, Winona, Minn.

INTERNATIONAL RAILWAY MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

MASTER BOILERMAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, excepting June, July, August and September, at Copley-Plaza Hotel, Boston.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July and August, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Minnesota Transfer Y. M. C. A. Gymnasium Building, St. Paul.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately—June, in Los Angeles and October, in Sacramento.

RAILWAY CLUB OF GREENVILLE. — J. Howard Waite, 43 Chambers avenue, Greenville, Pa. Regular meetings, third Thursday in month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

TORONTO RAILWAY CLUB.—R. H. Burgess, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August.

WESTERN RAILWAY CLUB.—C. L. Emerson, executive secretary, 822 Straus Building, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.

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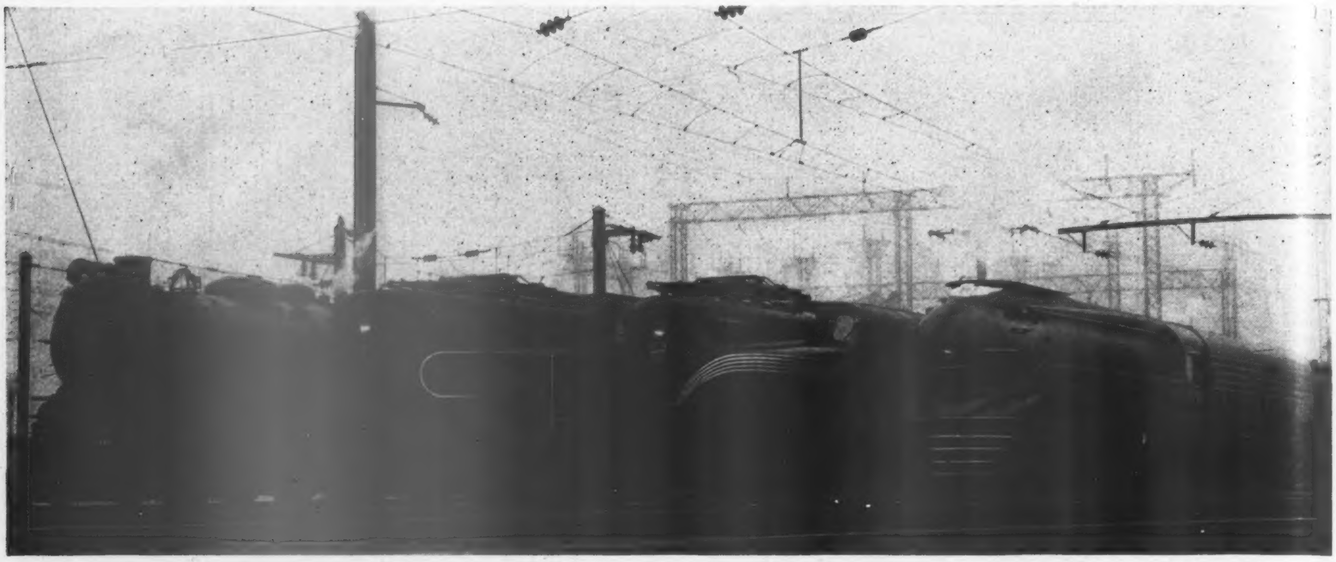
For explanation see page 178



Pennsylvania passenger motive power—K4s Pacific type (left), P5a and GG1 electric locomotives and the new streamline K4s Pacific type

NEWS

Air Resistance of Passenger Trains—A Correction

UNDER Figs. 15 and 16 in the article on Air Resistance of Passenger Trains in the December issue of the *Railway Mechanical Engineer* is the caption "Drag factor curves for the streamlined locomotive trains." The caption under Fig. 16 should have been "Drag factor curves for the standard locomotive trains."

Experimental Devices Not Within Boiler Inspection Act

IN an action against the Southern Railway for the death of the driver of the engine of a fast train in a derailment, the Supreme Court of the United States holds that where a mechanism known as Wright's Little Watchman, designed to stop trains or derailment, is attached to a locomotive it does not become a part or appurtenance thereof which the carrier is absolutely bound properly to maintain, under the Boiler Inspection Act, the evidence showing that the mechanism is in the experimental state. The court said: "With reason, it cannot be said that Congress intended that every gadget placed upon a locomotive by a carrier, for experimental purposes, should become part thereof within the rule of absolute liability. So to hold would hinder commendable efforts to better conditions and tend to defeat the evident purpose—avoidance of unnecessary peril to life or limb.

"Whatever in fact is an integral or essential part of a completed locomotive, and all parts or attachments definitely prescribed by lawful order of the Interstate Commerce Commission, are within the statute. But mere experimental devices which do not increase the peril, but may prove helpful in an emergency, are not. These have not been excluded from the usual rules relative to liability." Judgment for plaintiff was reversed.—Southern v. Mrs. Olivia Cox Lunsford, Admx. Decided March 2, 1936. Opinion by Mr. Justice McReynolds.

New Equipment

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of locomotive	Builder
Great Lakes Steel Corp.	1	73-ton, 6-wheel fireless steam	H. K. Porter Co.
Northern Pacific	12	4-6-6-4	American Loco. Co.

LOCOMOTIVE INQUIRIES

Road	No. of locos.	Type of locomotive	Builder
Alton & Southern	1	2-8-2	....
Louisiana & Arkansas	5	2-8-2	....
New York Central	7	Diesel-elec.	....

CAR ORDERS

Road	No. of cars	Type of car	Builder
Charles Lennig & Co., Inc.	1	50-ton tank	General American Trans. Co.
	1	30-ton	
Great Northern	500	Ore	American Car & Fdry. Co.
Wyerhaueser Timber Co.	75	50-ton logging	Pacific Car & Fdry Co.

CAR INQUIRIES

Road	No. of cars	Type of car	Builder
Erie	500	50-ton box	....
	300 [1]	50-ton auto	....
N. Y. C. & St. L.	500	50-ton box	....
	200	50-ton gondolas	....
	50	50-ton flats	....
	25	70-ton gondolas	....
	2	100-ton flats	....
Seaboard Air Line	125	70-ton phosphate	....
Pacific Fruit Express	3,000	Refrig. or underframes	....

[1] 100 to be equipped with loaders.

Air Conditioning

THE Atchison, Topeka & Santa Fe will air-condition 125 passenger cars.

The Missouri Pacific will continue its program of air-conditioning passenger equipment on a schedule providing for the conditioning of substantially all Pullman and coach equipment by July 15. While all principal trains are now so equipped, this year's program, when completed, will find practically every regular car in service air-conditioned and only a few remaining extra cars to complete the entire program. Approximately $918,000 will be expended this year in air-conditioning 93 additional passenger-carrying cars, of which 60 are railroad-owned and 33 are the property of the Pullman Company. The total number of air-conditioned cars in service on the Missouri Pacific, upon the completion of these 93, will be 228.

Special attention is also being given to modernizing the seating equipment, washrooms and lighting of coaches. An innovation in the equipment of coaches will be lunch counters for colored patrons. New effects in lighting are also to be installed

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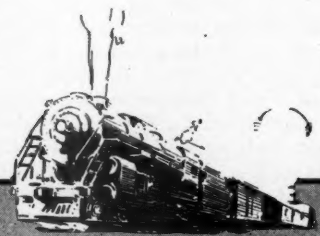

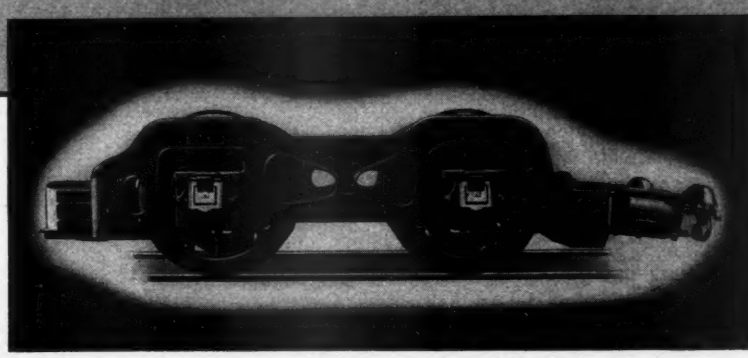

for the convenience of passengers at night and coach passengers are now ticketed through to avoid disturbance during the night hours.

Orders for air-conditioning equipment placed with the Pullman-Standard Car Manufacturing Company are: Northern Pacific, eight mechanical sets, to be installed in company shops; Minneapolis, St. Paul & Sault Ste. Marie, Pullman mechanical units for four solarium cars and Waukesha Motor Company mechanical units for three diners, all installation to be done in Pullman shops; Chesapeake & Ohio, mechanical units and installation for six coaches.

I.C.C. Modifies Rules for Locomotives Other Than Steam

The Bureau of Locomotive Inspection has sent out a circular covering modifications which have been made in the Rules and Instructions for the Inspection and Testing of Locomotives Propelled by Other than Steam Power, which will become effective May 1, 1936. These changes cover rules relating to hot water heating boilers in addition to steam heating boilers, provide that fuel tanks shall be equipped with gages indicating the level of the fuel and with suitable vents, also a few other changes to provide more adequately for certain requirements. A revised edition of the Rules is being printed and will be available in about 60 days.

Rule 205 (b)—The range in setting of governors for starting and stopping air compressors has been changed from 2 lb. to 5 lb.

Rule 213 (b)—Location of stampings on axles no longer specifies to be "on one end."

Rule 223 (a)—An additional clause relative to center plates for motor trucks provides that they shall be securely fastened and maintained.

Rule 229 (c)—Specification covering width of hinged cab windows has been omitted.

Rule 252—Revised rule provides that voltmeters and ammeters on units receiving power from outside sources shall be tested every six months (as at present), and on units driven from power generated within the unit every 12 months.

Rules 256 (a) and *323 (c)*—Provisions now specify that fuel reservoirs shall be filled and vented only from outside of the cab or compartment and that vent pipes shall not discharge on the roof nor on or between the rails. Revision also specifies that a fuel reservoir shall be equipped with a gage indicating the level of the fuel and that such gage shall be located so as to be readily visible to the person filling the reservoir.

Rule 302 (d)—A new clause limits the working pressure of cast iron boilers to 15 lb. per sq. in.

Rules 303 (b), 308, 309, 316, 317, 320—Rules have been amplified to include hot water boilers as well as steam boilers, and to include specifications for the application of water relief valves to hot water boilers. These rules cover testing, washing, and etc., of both types of heating boilers.

I. C. Diesel-Electric Locomotive

The first of three Diesel-electric locomotives has been delivered to the Illinois Central for operation in freight transfer service between Chicago and Markham Yard. It will make a round trip a day, supplanting two steam locomotives required for the same service. The first locomotive, No. 9200, built by the General Electric Company at Erie, Pa., has two 900-hp. Ingersoll-Rand oil engines. Driving motors on the two six-wheel trucks can be operated from cabs in either end of the locomotive. It is expected the locomotive will haul 62 forty-ton cars at a speed of 24 m.p.h. or 125 forty-ton cars at a speed of 13 m.p.h. The locomotive is 60 ft. long, 10 ft. wide, 15½ ft. high, weighs 342,000 lb., and costs $195,000. Its maximum tractive force is estimated at 102,600 lb., dropping to 39,800 lb. at 13 m.p.h.

Improvement Programs

The Chesapeake & Ohio will repair 1,700 steel hopper cars of 70-tons' capacity this year at its Russell, Ky., shops. This work will require about 7,000 tons of steel which will be furnished by the car builders.

The Delaware & Hudson will build 50 composite hopper cars of 50 tons' capacity in its shops at Oneonta, N. Y., and during the year will rebuild 100 coal cars.

The Norfolk & Western will spend $5,000,000 on an improvement program, including the construction at Roanoke, Va., shops of 1,000 coal cars and 5 Mallet locomotives; extension of yards at Roanoke, and at Williamson, W. Va., and additional sidings and yard facilities on its Buchanan branch.

The Western Pacific has asked permission from the Interstate Commerce Commission to issue $3,000,000 of trustees' certificates to be used in connection with its $3,900,000 program to be spent for deferred and normal maintenance and new equipment, including rebuilding 50 freight cars, rehabilitating 500 cars, air-conditioning 4 passenger cars, replacing arch-bar trucks with modern trucks on 1,000 cars and purchase of 100 steel hopper cars. The 100 steel hopper cars have been ordered from the American Car and Foundry Company.

The Lehigh Valley has authorized the construction in its own shops of 250 composite coal cars of 50 tons' capacity to be built of all new material; 250 composite and 500 all-steel 50-ton coal cars to be built of new and second-hand material. The 500 composite cars will be constructed at Sayre, Pa., and the 500 steel cars at Packerton, Pa. The cost of constructing these cars is being partly financed through the aid of the Federal Emergency Administration of Public Works.

Supply Trade Notes

Joseph L. Noon, eastern railway sales manager of The Glidden Company, at Reading, Pa., has been appointed manager of railway sales with headquarters at Cleveland, Ohio.

The Westinghouse Electric & Manufacturing Company on April 30 will return its New York executive and sales offices from 30 Rockefeller Plaza, New York, to its former location at 150 Broadway.

The International Nickel Company, Inc., New York, has established field representatives at Chicago and Los Angeles,

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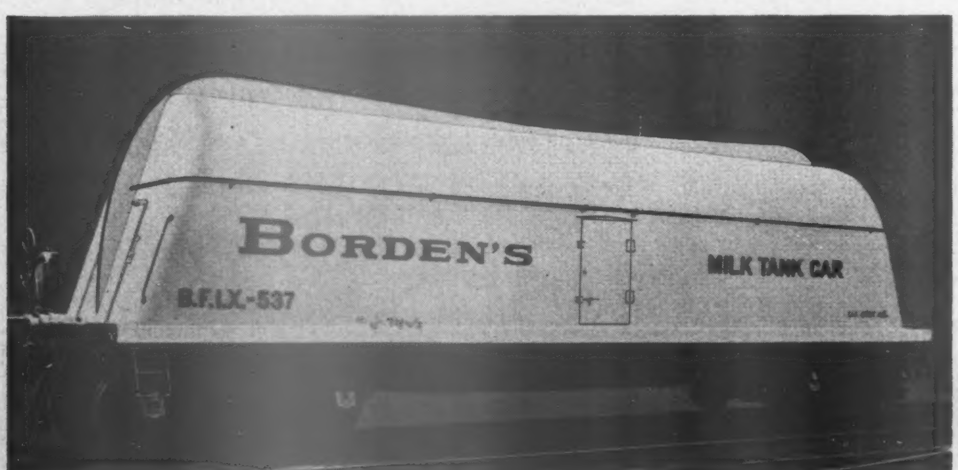


Streamline Milk Car.—The Borden Farm Products Company, Inc., is rebuilding its wooden tank milk cars and giving them a streamline appearance. These cars contain two 12,000 gal. glass lined milk tanks insulated with 6 in. of cork. They are of all-steel construction and arranged for passenger-train service. The sheathing consists of No. 10 gage steel sheets welded to the underframe and then sprayed with two coats each of molten zinc and molten aluminum. By rebuilding weight was reduced from 90,000 lb. to 84,000 lb.

Cal. H. L. Geiger is located at 333 North Michigan Avenue building, Chicago, and A. G. Zima in the Petroleum Securities building, Los Angeles.

HAROLD T. HENRY, eastern district sales manager of the Q & C Company, New York has resigned to become manager of railroad sales of the Burden Iron Company, Troy, N. Y.

THE DAMPNEY COMPANY OF AMERICA, Boston, Mass., has opened a branch office at 220 Bagley avenue, Detroit, Mich., in charge of C. M. Boling, who was formerly resident engineer at Cleveland, Ohio.

THE R AND C COMPANY, C. D. Hicks and W. E. Hicks, 1218 Olive street, St. Louis, Mo., have been appointed southwest representatives for the Wilson Engineering Corporation, Chicago.

FRANCIS HODGKINSON, consulting mechanical engineer of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has retired after 42 years of service with the Westinghouse Company.

J. R. C. HINTZ, until recently railway sales division manager of the Detroit Graphite Company, has been appointed eastern sales representative of the Acme White Lead & Color Works, Detroit, Mich., with headquarters in New York.

L. F. SWEENEY has been appointed assistant to the vice-president of the Standard Stoker Company, Inc., Chicago, vice C. T. Hansen, who has been appointed district sales manager, in place of R. J. Schlacks, resigned.

FRANKLIN C. VANDERVORT, JR., has again become associated with Johns-Manville Sales Corporation, with headquarters at Chicago. Mr. Vandervort was formerly associated with the Transportation department, and is now re-entering the Johns-Manville service as representative in the western region of its sales organization.

THE HEYWOOD-WAKEFIELD COMPANY, Gardner, Mass., has leased the entire east end of the first floor at 1 Park avenue, New York City, which was temporarily occupied by the company. At this address the company will maintain displays of its regular furniture lines, also of railway and bus seats, etc. The offices of its Railway Sales division and New York sales offices will be located at this address.

DANIEL B. WORTH has joined the locomotive department of the Cummins Engine Company, Columbus, Ind., and his duties will be directly connected with that department. Mr. Worth was formerly associated with the Baldwin Locomotive Works and he has a wide experience with many types of internal-combustion engines as applied to railroad use, his previous work having been in designing, building and servicing such equipment.

ALFRED MUSSO, of New York, and Robert Kemp, of Troy, N. Y., and O. A. Van Denburgh, of Troy, have been elected president, vice-president and secretary, respectively, of the Burden Iron Company, Troy, N. Y. Arthur E. Swan, former chief engineer of the Crucible Steel Company of America, Harrison, N. J., and James D. Fleming, commissioner of industrial affairs, Troy, have been elected to the board of trustees along with the new president, vice-president and secretary.

CARL W. BETTCHER has been elected vice-president of the Eastern Machine Screw Corporation, New Haven, Conn. Mr. Bettcher has been with the company for 17 years.

E. E. GRIEST, vice-president in charge of manufacture of the Franklin Steel Works, Franklin, Pa., has been elected vice-president and general manager of the Fort Pitt Malleable Iron Company, Pittsburgh, Pa. Mr. Griest was born in Zanesville, Ohio, and graduated from Purdue University in 1907. He served as a machinist apprentice, machinist and foreman in the Pennsylvania shops at Columbus, Ohio, from 1900 to 1904, and for a short time following graduation in 1907 was employed in the engineering department of the Crucible Steel Company of America. From 1907 to 1908, he was a machine shop foreman on the Erie and from 1908 to 1918 was assistant general foreman, assistant master mechanic and master mechanic, respectively, of the Pennsylvania at Ft. Wayne, Ind. In the latter year he became assistant general superintendent of the Chicago Railway Equipment Company and in 1919 was appointed general superintendent. From June 15, 1931, to February 15, 1936, he was vice-president in charge of manufacture of the Chicago Railway Equipment Company, the Grand Rapids Malleable Works, the Marion Malleable Iron Works and the Franklin Steel Works.

Obituary

J. E. FORSYTHE, inventor of the Forsythe draft gear and other devices for cars. died on March 7 at Chicago.

JOSEPH P. MCNALLY, sales engineer for the past several years for the Iron & Steel Products, Inc., Chicago, died on February 29 at his home in Chicago. He was 68 years of age.

Personal Mention

General

HARRY G. MILLER, chief inspector of the Chicago, Milwaukee, St. Paul & Pacific, has been appointed engineer of tests at Milwaukee, Wis., to succeed A. G. Hoppe.

T. J. CLARK, superintendent of motive power of the Great Northern at Spokane, Wash., has retired after 52 years of service with this company.

ALFRED G. HOPPE, engineer of tests of the Chicago, Milwaukee, St. Paul & Pacific, has been appointed assistant mechanical engineer, with headquarters as before at Milwaukee, Wis.

T. M. CANNON, a draftsman in the mechanical engineer's office of the Chicago, Milwaukee, St. Paul & Pacific at Milwaukee, Wis., has been appointed chief inspector, with headquarters at Milwaukee, Wis., to succeed H. G. Miller.

JOSEPH B. BLACKBURN, who has been appointed engineer of motive power of the Advisory Mechanical committee of the Van Sweringen Lines, with headquarters at Cleveland, Ohio, was born on August 17, 1898, in Essex county, Va. After graduating from Virginia Polytechnic Institute in 1921 with a degree in mechanical engineering, Mr. Blackburn taught mechanical drawing in Norfolk, Va., for about three years. He entered railway service on May 1, 1924, as a draftsman in the mechanical department of the Chesapeake & Ohio at Richmond, Va., being appointed special mechanical inspector on February 1, 1929. After only a month in the latter position, Mr. Blackburn was appointed chief draftsman and a year later was advanced to mechanical engineer. On January 1, 1932, he was reappointed draftsman at Richmond and on August 1, 1933, became mechanical inspector. In March, 1934, he was appointed mechanical inspector on the Advisory Mechanical committee of the Van Sweringen Lines, and on December 1, 1934, was appointed to the position of equipment inspector on the staff of the mechanical vice-president of these lines, with headquarters at Huntington, W. Va.

Master Mechanics and Road Foremen

S. T. KUHN, general enginehouse foreman of the New York Central at Collinwood, Ohio, has been appointed assistant master mechanic, with headquarters at Collinwood.

L. E. ALLARD has been appointed assistant master mechanic on the Kansas City Terminal division of the Missouri Pacific, with headquarters at Kansas City, Mo., succeeding R. H. Tait, retired.

FRANK J. REGAN, road foreman of engines on the Northern Pacific, has been appointed acting master mechanic of the St. Paul division, with headquarters at St. Paul, Minn., succeeding N. E. Entrikin, who has been granted a leave of absence.

Car Department

H. A. SJOGREN has been appointed assistant to the superintendent of the car department of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Milwaukee, Wis.

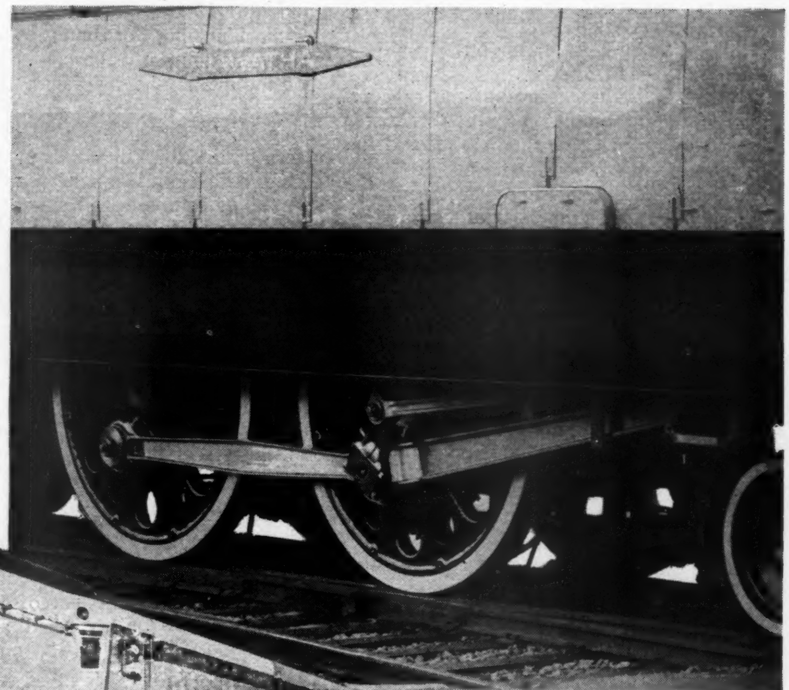
Shop and Enginehouse

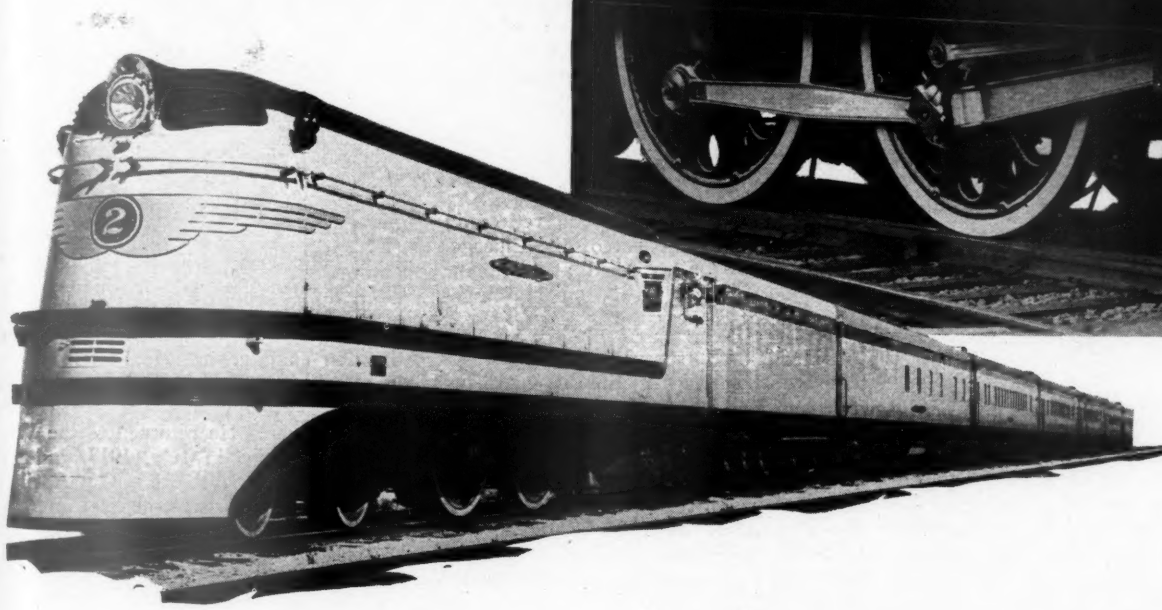
H. M. GARDNER has been appointed enginehouse foreman of the Erie, with headquarters at Susquehanna, Pa.

J. L. HUGHSON has been appointed night general enginehouse foreman of the Erie, with headquarters at Hornell, N. Y.

(Turn to next left-hand page)

HIAWATHA'S SUPERB PERFORMANCE





Demonstrates the Economic Advantages of Alco Quality Forgings . . .

ALCO

TO go on making this 410-mile high speed run between Chicago, Milwaukee and St. Paul on a 6-hour, 30-minute schedule with sunrise certainty is a noteworthy performance.

It demonstrates unquestionably the absolute necessity for forgings of unusual structural stamina for it is their unfailing endurance which insures the continued serviceability of the entire locomotive unit in this high speed service.

ALCO materials are carefully selected and scrutinized — forging temperatures are scientifically correct — every detail of fabrication is under constant and precise control at all times.

ALCO main rods, side rods, crank pins, axles and other forged parts are on America's fastest locomotives. They are specified for safety — economy — and thorough dependability in every kind of heavy duty and high speed service.

To get ALCO quality, strength and performance you must specify ALCO Forgings.

AMERICAN LOCOMOTIVE COMPANY

ALCO FORGINGS

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G. R. SEITZ has been appointed general foreman of the back shop of the Erie at Hornell, N. Y.

JOHN F. MURPHY, assistant general foreman of the locomotive shops of the Boston & Albany at West Springfield, Mass., has been appointed superintendent of shops, succeeding John H. Minette, deceased. Mr. Murphy was born in 1880 at Springfield, Mass. He attended the public and evening

J. F. Murphy

trade schools, and on May 1, 1898, became a helper in the enginehouse of the Boston & Albany. In 1902 he was transferred to the shops and in 1908 was the first apprentice to serve his time on the Boston & Albany. He then became a machinist leader and in 1912 was promoted to the position of machine shop foreman. In 1928 he was appointed assistant general foreman of the locomotive shops, and since July of last year had been acting superintendent of shops. Mr. Murphy is one of the organizers of the Boston & Albany Supervisors' Club. He has always been an active supporter of apprentice training.

H. C. DIETRICH has been appointed general foreman of the New York Central, with headquarters at Root street, Chicago.

C. A. PEASE, assistant foreman at the enginehouse of the New York Central at East Buffalo, N. Y., has been promoted to the position of terminal foreman, with headquarters at Harmon, N. Y.

Obituary

LAMBERT N. HOPKINS, who retired in 1928 as purchasing agent of the Chicago, Burlington & Quincy, died at his home at Santa Barbara, Calif., on March 17 at the age of 84 years.

J. H. MINETTE, superintendent of the locomotive shops of the Boston & Albany at West Springfield, Mass., died on February 29. Mr. Minette was born on March 3, 1872, at Danby, Vt. He attended Springfield evening schools; Burr & Burton seminary, Manchester, Vt., and took correspondence school courses. He served as a machinist apprentice at Manchester and in 1892 went to Springfield where he was employed by the Barney & Berry Skate Company in various departments for 10 years. He also worked as a machinist in the Knox and Stevens-Duryea automobile

J. H. Minette

plants. His service with the Boston & Albany began in 1904 as a machinist at the repair shops in West Springfield. He was appointed shop draftsman in 1914 and valuation engineer in 1915, the latter assignment carrying him to all parts of the Boston & Albany and the New York Central system. He returned to the West Springfield shops in July, 1918, and was assigned to special work. On April 1, 1919, he became assistant general foreman; on November 1, 1927, general foreman, and on January 1, 1929, superintendent of the locomotive shops.

MARINAC'S RAIL ODDITIES

MARINAC has furnished us with the following explanations of the three cartoons which appear elsewhere in this issue:

Page 155. King of Hoboes! The whistle of a train is music to his ears—it's the call of the open road. For 23 years he has been King of the Hoboes' Union of America. He won his crown by election. All real hoboes join the union. To become a member they must agree to assist all runaway boys and induce them to return to their homes and parents. King Jeff Davis wants it understood that the term hobo does not mean bum. A bum never works, while hoboes are deserving but restless men who travel and work when they find work.

Page 164. Mr. Hodges, a veteran retired engineer, tells of an amusing but interesting event that occurred last summer. A sparrow built its nest on a coal car during one of its intervals of staying in the city. When the train went out the mother bird rode serenely upon her nest of eggs. Soon the five birds were hatched, but now the story was different. The mother bird was out early each morning obtaining food for her birds. When the train left the mother bird stayed at home, but when the train returned in the evening she had an assortment of grub-worms, angleworms and other insects piled up near the tracks, and in this manner gave her traveling family a good supper each evening. This program was carried on by the mother bird until her offspring could fly.

Page 174. People of Augusta, Ark., are proud of the Augusta Tramway & Transfer Company, which they claim is the shortest railroad in the country. With pride they point to the single mile of track which connects their community with the Missouri Pacific to the south, and to the somewhat antiquated locomotive that pulls cars loaded with cotton from their fields to the main line. But they are much prouder of 14-year-old Joyce Short, who, when she is not in school, sits in the cab of the 22-ton locomotive and handles the throttle with all the skill of a veteran engineer.

Engineer Short is no novice who runs the engine for a lark. She is a real railroad "man" and knows her "iron horse" from stem to stern. When this piece of rolling stock has to go into the roundhouse for attention she is on the job with wrench and oil can and does not have to be told what to do. Joyce came by her interest in railroading naturally. Her grandfather has been with the A. T. & T. going on 35 years. Her father, who died in 1922, also worked for the road.

John Short, her grandfather, hoped that he would have a grandson who could carry on the family tradition and he was a happy man when Joyce came to him and begged to be allowed to learn all there is to learn about running America's shortest railroad. At first he was skeptical, but he gave the girl a chance and she took to locomotives as a duck takes to water. For months she worked in the roundhouse and actually seemed to enjoy coming home at night covered with oil and soot. To the surprise of the men employed by the road, she revealed genuine mechanical ability and learned the construction of a locomotive as well as she did her lessons at school.

When her grandfather thought she knew enough about the engine to sit at the throttle, he took her in the cab with him and showed her all the tricks of driving an "iron horse" with a string of cars behind it. He showed her how to get the most out of the machine, how to ease it around curves and all the other tricks that engineers have to know to hold their jobs. Then he let the youngster demonstrate what she had learned. After a few runs up and down the mile track with her grandfather standing by, Joyce was allowed to pilot alone and she is now a full-fledged engineer.

The schoolgirl is a perfectly normal young woman with a flair for railroading. The builders of the little railroad would probably turn over in their graves if they could see a slender girl in her teens driving a locomotive over the tracks they laid 47 years ago. In those days the road carried passengers as well as freight, but the owners did not have enough money to buy an engine and the cars were pulled by mules. The one passenger coach was a second-hand trolley car which had seen service on the streets of St. Louis.